

# AVIATION WEEK

A MCGRAW-HILL PUBLICATION

January 27, 1958 75 cents

**USAF School  
Seeks Answer to  
Space Survival**

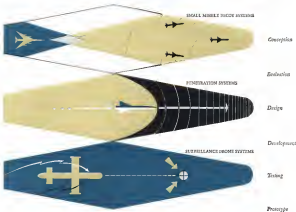
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## DRONE and SMALL MISSILE SYSTEMS

The research and development activity at Rheem Aircraft Division has a record of achievement in the field of drone and small missile systems.

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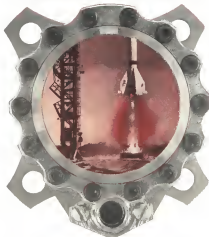
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## AVIATION CALENDAR

(Continued from page 8)

Feb. 19th—An Flying Saucer Port or  
Faint? Dr. Hugh Wynn, Marine and  
Ordnance Systems Department CTF 10  
—Cdr. C. B. D. D. D. D.

34th 54th—Third Annual American Society of Mechanical Engineers Gas Turbine Conference and Exposition, Sheraton Hotel, Washington, D. C.

Mar. 14—Second Annual Shark Tube Symposium, Fife, Mo. Call for details: [water-commander@4a-force.com](mailto:water-commander@4a-force.com) Special Weapons Center, Kirtland AFB, N. M., Attn: B. B. Boudreau 50535.

Mar. 13-14-Symposium of the Anatomical Sciences National Flight Propulsion Meeting (Secret clearance required)  
Hotel Cater, Cleveland, Ohio

May 23-24-25th Annual Heat Transfer Technical Conference, California State University, Fullerton, CA

Min. 1932, *Journal American Cardinals*,  
Lancaster, Boston Society American, 50

May, 17-21-1955 Nuclear Congress, was held by American Institute of Chemical

Figures 15 W, 45 B, New York, Co.  
 18-19—Condenser on extremely high  
 temperature (over 1800°C), sponsored  
 by USAF Cambridge Research Center.

Mass. 10-19—First Int'l Service and Industry Symposium on Control Manifold Training Equipment donated to those with severe

(Donnerstag) Nördlicher Ozean: Expedition  
White Oaks, Silver Springs, Md. Die  
Details unter: Mr. J. C. Voss, Head of  
New Wisconsin & Southern Division, U. S.

Mr. D. H. D. Institute of Radio Engineers  
National Convention, Waldorf-Astoria  
Hotel and New York Coliseum, N. Y. C.

Mar. 24-25—Fourth International Inter-  
west Siam Convention Hall London  
Mar. 30-Apr. 1—R.F.C. HMAS Richmond  
(World War II) Toronto, Canada Con-

Apr. 8-10—English International Symposium  
Electronic Wargames, Microwave, Re-

Age: 16 1/2-14th Annual National Forum

Apr. 17-18—Institute of Environmental Engineers Second Annual Technical Meet-  
ing, 1974, Sheraton Hotel, Washington, D. C.

Apr. 12-14-1955 Electronic Components Conference, Automobile Hotel, Los Angeles, Calif.

Age: 2004—Second Annual Atmospheric Conference, sponsored by Air Force Office of Scientific Research and Institute of Atmospheric Sciences, Shirley Saxon (Montgomery, Ala.)

May 47—Fourth National Flight Test in Commemorative Symposium, Pullman Hotel, New York City

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**T 58**



...and General Electric for the breakthroughs in performance, reliability, safety and maintenance that stemmed from the development of this high-power, low-weight turboshaft engine. We of the Jet Division of Thompson Products are proud to supply turbines and compressor components for the T56.

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▲ Among new, fast military aircraft being equipped with the ASN-7 Automatic Navigation Computers are the McDonnell Voodoo RF-101 photo-reconnaissance plane, shown above, and the B-105B all-weather transport. Prior to using a new world's closed-course speed record of over 1200 mph, the Voodoo had no new spontaneous speed records. Speed and course of the Voodoo gave full scope to the ASN-7's usefulness. Light indicator dial and control panel (right) give pilots an indication of where they are, their ground track and the course and distance to their destination and to alternate destinations.



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General Electric 5-Star high reliability tubes—Types 5902, 6111, and 6112—help make the new ASN-7 course and distance computer a more accurate continuous-data navigation system.

The ASN-7 was designed and built by the Ford Instrument Company division of Sperry Rand Corporation, under the direction of Wright Air Development Center. Simplicity of operation, plus a continuous feed-in of wind and magnetic variation, enable the system to serve as a dependable navigation

guide, from take-off through mission to fuel landing.

Three computers, two amplifiers, a dual indicator, and a control console make up the complete ASN-7. Tubes must perform to highest standards. "We found that General Electric tubes met our requirements for reliability, ruggedness, and versatility," affirms Ford Instrument engineers.

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And Harrison keeps pace with this outstanding performance. For North America has selected lightweight, dependable Harrison heat exchangers to cool the engine oil, to keep temperatures at the proper level for this spectacular jet fighter.

The Super Sabre is another example of how Harrison manufacturing experience and research are teaming up to meet the temperature-control challenges of the jet age. If you have a cooling problem, look to Harrison for the answer!

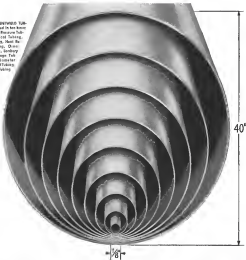
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To insure that Trentweld tubing

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## waldorf advanced flight instrumentation

Waldorf works closely with the customer, whether it be prototype or production runs, meets his most exacting specifications through their own unique design and production techniques.

The complete facility combines creative engineering and advanced production methods with practical experience.

Shown here are just two samples of Waldorf's technical creative abilities. The top unit is an integrated flight instrument showing a moving average of altitude against a fixed horizon. Its presentation is unique in that the aircraft moves about 3 miles, pitch, roll and rate of turn. And another design feature is a rotatable course-orient which permits setting any desired heading at the top of the instrument... Another simplifying the pilot's job. This unit is used in fixed wing aircraft — turboprop or jet-powered — as well as in rotary wing type aircraft and features a standard 12" size.

The bottom unit shows how which illustrates a mechanical optical display technique utilized with Waldorf as developed for the Aeronautical Instruments Laboratory, Naval Air Development Center, Johnsville, Pa. adds new dimensions to flight instrumentation. Due to the classified nature of this item, further information can be made available to organizations upon proper security clearance.

Waldorf has a proven capability in providing integrated flight instrumentation as based on electro-mechanical, optical and video techniques. In experienced management, engineering, production know-how solve your particular problem in these areas and is immediately available to discuss these matters with you.

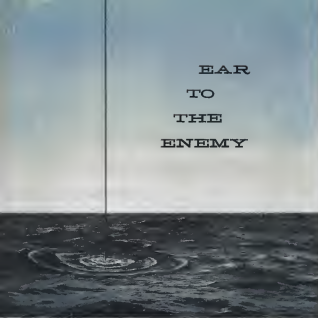
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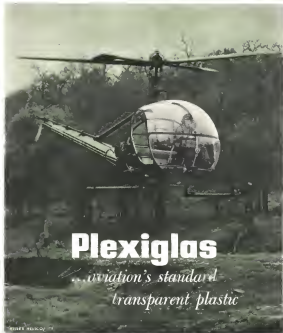


## DUNKING SONAR — LISTENING SONAR — ECHO RANGING SONAR — LIGHTWEIGHT TORPEDOS

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## THE VITAL LINK IN MISSILE PROGRESS

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It, of course, makes sense to be built — for whatever purpose — the first requirement is adequate measuring equipment. The equipment must be rugged, accurate, and reliable and have the capacity for the job at hand. It must bring back the thousands of data points that tell the story and make the best use of the most sophisticated of flow and mass.

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Flank heating accelerations on Monday, Feb. 20, 1990 and February 20-21st, 1990 at the central Sydney airport, Sydney, New South Wales, Australia.



## ROLLWAY BEARINGS

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**Bahan baku:** beras, ubi kayu, jagung, kacang kedelai, gandum, tempe, tahu, telur, ikan, ayam, daging sapi, lemak babi, minyak sayur, gula pasir, garam, cuka, kecap, bumbu dapur, air.



## New B. F. Goodrich laboratory is proving ground for fuel cells



B. F. Goodrich Aviation Products' new Fuel Cell Development and Testing Laboratory at the big BFG Los Angeles plant is the best work in fuel cell research. Here, engineers maintain constant quality checks on cells being produced for many aircraft including the Lockheed 3045, T-38 and F-104, the Boeing B-52, the Douglas F4D and the Northrop F-5B. In addition,

fuel cell designs and materials are being developed to meet the requirements of future airplanes and in the driving boards.

A representative sample of the laboratory's facilities is shown here. Among the specialized types of apparatus are a power box and test areas, control for oxygen, nitrogen and vibration, and many more.



**FABRIC TEST.** B.F. Goodrich technician examines new fuel cell fabric; this has undergone a new testing and process test in 70°F oven.



**"LEAK" TEST.** Steel gas flow meter 35,000-psi fuel through 700° inside to determine capacity of isolated fuel cell in simulated test pressure.



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For more details on how BFG is making better fuel cells for today and tomorrow, send for the free booklet "B.F. Goodrich—Fuel Cell Development and Testing Laboratory."

## The Critical Role of ARPA

The Advanced Research Projects Agency recently created by Defense Secretary Neil McElroy is a result of a specific directive from the White House to the potential to accomplish tremendous results or to critically cripple the vast new weapons development programs that are so essential to the future survival of the nation. ARPA, perhaps more than any other portion of the Defense Department except the comptroller's office, could be the key to whether our military posture will rise again to a position of clear and unchallengeable superiority. ARPA should have little concern with the past except to avoid the tragic errors that total ruin and unproductive outbursts have constituted in past development history. Its concern is with the future, beginning primarily with the exploration of space and development of radically useful space vehicles and equipment.

The major problem in maintaining a U.S. position of significant superiority in the technological race with the Soviet Union is not our technical, human, industrial resources or even the shortage of an engineering shortage. It is the type of men who are appointed to key positions along the decision-making chain governing military research and development and the length, vagueness and uncertainty that has developed by restriction during the past decade. It has primarily in the latter upon loss of resources that cover the basic research and advanced development effort of the working level military science-industry complex like an asbestos blanket, suffocating bold new concepts and suggest action with equal facility.

ARPA has an excellent chance of becoming just another and even more suffocating layer of bureaucracy step by step stifling research and development of weapons. Appointment of William Holaday as acting director of ARPA indicates a trend in this direction. Mr. Holaday's poor performance in the Pentagon shows an unwillingness for the old hat approach, using further study as a method of avoiding decision. He also shows a strong trend toward political compromise as a solution of technical problems that cannot be compromised without ultimate disaster.

Mr. Holaday's decision to put both the USAF Thor and Army Jupiter intermediate range missiles into production indicates he has difficulty distinguishing between a weapon and a weapon system. His more recent decision to separate the detection phase of the anti-missile system from the development of the guidance and guidance system portions again emphasizes his almost total lack of understanding of the weapon system concept. Recognition of which military service is to operate the missile defense system the act of splitting development of its basic components into two separate military and industrial management problems is a guarantee of critical future problems at the very time the system is scheduled to be operationally effective.

Another holdover from the technically biased regime of former Defense Secretary Charles E. Wilson is Donald Quarles, who now functions as Deputy Secretary of Defense after years service as Secretary of the Air Force and Assistant Defense Secretary for Research and Development. Although Mr. Quarles' career in Western

Electric and the Bell Laboratories was largely administrative, he has clocked himself in the Defense Department with the name of a technical expert. He has not hesitated to veto the concerns of genuine technical experts on the strength of his personal opinion or arbitrary budget directives.

An examination of Mr. Quarles' public statements reveals that he has been more consistently wrong in understanding the pace of Soviet technical development than anybody in the Defense Department except Mr. Wilson. Even today, he is unwilling to admit that it poses any unusual problems for the future defense of this country. Mr. Quarles has also sung loudly in the official chorus that attempted to deny the existence of any Soviet weapons even when the facts on their performance were well known as the Pentagon.

It is also interesting to evaluate some of Mr. Quarles' major technical decisions that are not so clear publicly in light of his future qualifications to influence the pace and scope of ARPA work. A few years ago when the Air Force research and development budget was being seriously squeezed under a constant level budget policy, that prevented acceleration of key basic research and critical development areas in which our position is now being challenged by the Soviets, Mr. Quarles, as Secretary of the Air Force personally oversaw the unanimous position of the Air Council and USAF's research and development experts in rejecting a more adequate program to Congress. Two years ago, a USAF general of years' battle experience of its top research and development commanders proposed a program of military useful space research, including consolidating all space research activities around the nucleus already existing at Hurler's Air Development Center. This plan too was immediately vetoed by the Air Council but personally vetoed by Mr. Quarles on the ground that it involved spending money to no good purpose. Six months later, USAF tried again with a program to develop an exploratory space vehicle. This too got Mr. Quarles' personal veto.

The poor performance of Messrs. Holaday and Quarles on matters of critical technical dimensions also gave doubts as to the wisdom of continuing to entrust them with this critical activity, particularly as it relates to ARPA. It will be difficult for even the best man that could be found to lead ARPA, so much effort truly is an atmosphere dominated by the Quarles-Holaday philosophy. It also will be extremely difficult for ARPA to work out the complex and effective relationships with the already operating research and development programs of the country with the same type of acerbity that characterizes the vast majority of the 2,000 employees in the office of the Secretary of Defense. They and this system have proved utterly incapable of moving with sufficient speed, imagination and daring to play for the tremendous stakes worked in ARPA's program activities. There are some of the pitfalls Donald Quarles' McElroy must avoid if he is to make ARPA a vital success. Next week we will discuss some of the possible causes of attack that could make ARPA effective and successful.

—Robert Holt

## In the Front Office

Mr. Ruth Houghton Ace and Eric Gabor, investment executives, directors of the Irving Trust Corp., Inc., reviewing the board membership by name is a list of clues.

K. R. Hansen and C. G. (Babe) Hertz, executive vice presidents, Henry Ford Corp., New York, N. Y. J. P. Fowler succeeds Mr. Hansen as president of Volvo, Inc. A. J. (Jack) Hertz, vice president of Sperry Gyroscope Co., director of Sperry Rand.

Dr. Carl L. Kahn, vice president and technical director, Chrysler Division Aero Manufacturing Corp., Cincinnati, Ohio.

Dr. Felix A. Kalkule, vice president in coordinate and direct contracts, customer relations and engineering division, Vought Aircraft Corp., Morton, Pa.

Dr. G. E. Kline, vice president, Southwestern Bell Corp., Atlanta, Ga. Lt. Gen. Lawrence C. Kline (USAF, ret.), a vice president, American Machine & Foundry Co., New York, N. Y., in charge of the company's helicopter division program.

William C. Kohn, vice president/president, John A. Roebling's Sons Corp., Trenton, N. J.

A. W. Kohn, vice president/managing, International Controls Co., Kalamazoo, Mich.

Paul W. Elliott, a vice president, K. Y. Potter Company, Inc., New York, N. Y.

## Honors and Elections

Dr. Louis N. Kohn, chief scientist of the Lockheed Missile Systems Division, has been named to the National Academy Committee for Aerospace, newly created Committee on Space Technology.

## Changes

Joseph E. Malachuk, director-credit product engineering and manufacturing, and Henry C. Gabor, chief engineering, product test. The Lockheed Corp. division of Aerospace Machine & Foundry Co., Dayton, Ohio.

James J. Shanley, general manager, V. H. Gorman, Director, Caltech Institute Inc., Berkeley, N. J.

F. H. Hays, assistant managing director, North American Aviation, Inc., Dayton, Ohio. Ralph E. Hays, Director, Caltech Institute Inc., Berkeley, N. J. Edward E. Newman, manager, Missile Products Division, Federal Ordnance Co., Detroit, Mich.

Edwin A. Spindler, manager of planning, Defense Electronic Products, Radio Corporation of America, Camden, N. J.

Charles A. Wall, director of marketing, Autonetics Division, North American Aviation Inc., Dayton, Ohio. John Thacker, Director, product manager, Avco, Inc., Woodside, N. Y.



Now 8 ozs. do the work of 70-

Honeywell's new miniature integrating gyro (MIG). With a maximum drift rate of only one-half degree

per hour or less and a random drift uncertainty of .05"/hr.—even after subjection to severe environments—the MIG compares performance-wise to hermetic integrating gyros many times larger and heavier.

## Specifications

Weight—8 to 12 lbs.  
Size—18 in. diameter by 21 in. h.

Applications—Phonograph for recording, space, all attitude reference and inertial applications.

Drift Rate—One half degree/hour or less under all conditions.

Accuracy—0.05"/hr.

—Honeywell Corp.

Power Requirements—10 watt 3-phase, 480 cycle per minute supply

115 volt a.c. 60 c. 3-phase supply

Rating Power—1.5 watt rms

Angular Momentum—200,000 g-m/cm<sup>2</sup>/sec

For further information write: Honeywell Corp., Division Dept. 270-1-11, 1000 University Road, St. Paul, Minn.



Photo shows MIG Gyro with computer case, GGG-1000. The gyro has diameter of 18 in. and weight of less than 8 lb. up to 100 g.

# Honeywell

**H** Military Products Group

## INDUSTRY OBSERVER

New approach to missile development will be tried soon by Navy's Bureau of Aeronautics in an effort to cut the development cycle for missiles and air-to-surface missiles. Under the new policy, BuAer initially will avoid a contract until the development of the guidance system—bought from the developer—has been sufficiently developed to establish feasibility with the bureau select a prime contractor to develop the missile and its powerplant.

Westinghouse and General Electric are top candidates for the design and construction of a complex high-temperature electrical system for North American Aviation's WS-133A short-range bomber. Electric's installation will have to meet operational requirements not previously encountered in any manned aircraft.

Navy Air Missile Test Center, Ft. Meigs, Calif., will modify the launching pad area being used for Rascal II tests so that it can accommodate test vehicles of the Polaris fleet ballistic missile scheduled to be fired over Meigs's sea range.

General Electric J79 turbojet engine has a 94 in. long variable inlet guide vane, indicating an instantly high air capacity considering the powerplant's 33 in. compressor diameter. J79A, designed for Navy, has a shorter and less frame of steel instead of titanium as in the J79B engine used in Lockheed's F-304. J79A is projected as a powerplant growth for the Convair B-58. The J79B is an F-104 growth project and will have a 2 in. larger turbine diameter than earlier models. All will have more thrust and better fuel consumption than the first J79 production engines.

Aerospace Manufacturers Board will meet industry progress within the new format for both an air-ground data link system for operational evaluation and a point-to-point data link system for transfer of data between traffic control computers of adjacent Air Route Traffic Control Centers.

Watch for Fiat's Avio Division to make a strong entry into the small and medium turbojet engine field later this year. Company already has developed small turbojets as a means of power expansion and as the powerplant for one of the firm's new helicopters. It will soon branch out into the higher thrust brackets.

Vertical takeoff jet fighter being developed by Bell Aircraft for Navy reportedly looks so promising that Air Force is providing some support funding. If project continues to gain out USAF, could be the Bell VTOL, and climatic or combat in projected design competition for a dispersed site fighter-bomber for Strategic Air Command bases.

Equipment for tactical intermediate range ballistic squadrons now calls for a complement of 20 missiles with a 1000 speed limit. Squads have chosen one fully assembled, ready-to-use missile with warhead on reserve for every 10 in the tactical complement. It would be a tactical complement not function as test, reserve missile will be immediately moved in to replace it. Maintenance of missile will be required when time allows.

Bell Helicopter Division in Fort Worth is competing with Contractors Aeronautical Division Agusta on the helicopter design of one of two helicopters the Italian firm is developing in order from the Italian Air Force. Bell Helicopter project a joint-captain, probably in the six-ton weight class category. Second project, currently designed by Agusta engineers, is much larger, powered by gas turbines.

Paggio 166, landplane version of the twin-engine executive amphibian sold in the U. S. as the Royal Gull, is nearing the end of the company's flight test program. Certification tests made for both Italian airports, and the Civil Aeronautics Administration will begin before the end of the month. Aircraft has the same powerplant, wing and landing gear as the Gull, but the fuselage is larger, has room for two additional passengers.



## MISSILE GUIDANCE SYSTEMS

### Projects of H. T. Budenbom,

#### Senior Scientist, Stavid Engineering, Inc.

Included in Mr. Budenbom's 26 patents and numerous technical papers are his original contributions to successful development and authorship of many new patents in the application of electronics to modern warfare. His experience and inventive talents are being applied to Stavid's projects in weapons systems development and missile electronics. Mr. Budenbom is one of a group of outstanding scientists and engineers at Stavid who are working on advanced concepts years ahead of actual systems development.

In Stavid's objective engineering, scientific, development and manufacturing teams are producing a wide range of electronic systems for all branches of the military. A typical project calls for development of the high power Radar for AN/SWS-2.

**STAVID Engineering, Inc.** Patented, New Jersey

*Imaginative Electronics...*

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- Radar-Infused Airborne Fire Control System
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## Washington Roundup

### Censorship Review?

Department of Defense censor's deletion of certain testimony, given before the Senate Preparedness Subcommittee could reach all sensitive congressional inquiries into the government's counterdrug policy. Strong subcommittee expressed considerable dissatisfaction with deletions which, they said, left the impression that USAF Gen Nathan F. Topping chairman of the Joint Chiefs of Staff. Heated the subcommittee investigation by regarding the "moral conclusion" that the U.S. is militarily inferior to Russia.

In the deleted scenario Gen Topping specifically said, "I am not talking about these hearings."

The scenario was later released by the Defense Department with the explanation that then had been deleted because the question asked of Gen Topping that led to the scenario referred to a price exchange on which one passage did not contained security information.

In the official transcript of one witness's testimony, several pages were deleted entirely. Complete exchanges were deleted in others and, in some cases, figures pertaining to production, delivery times and similar matters were cut out.

### President's Refusal

President Eisenhower politely refused last week to make the Killian and Gurnea Panel reports on the nation's defenses available to the Senate Preparedness Subcommittee investigating national defense. The President in a letter to Sen Lyndon B. Johnson (D-Tex.) said: "I am sorry that I cannot do this. I am sure that the reports would be helpful to the subcommittee." He added, however, that, as a result of the investigation the subcommittee is in a good position to focus its own conclusions on just where the U.S. stands in the military/technological race with the Soviet Union.

### Indigestion

The President's mission to Europe, making also led to a mauling of Central Intelligence Agency's dash intelligence agency. As a result National Security Council's CIA Director Allen W. Dulles reportedly complained that mauling of the agency is too low among top policy makers. An unnamed Eisenhower official said that the agency is too ponderous and paralytic, that, besides, it is too cumbersome—made up of too many overlapping strategic units. In return, the President plans to make sure the policy makers do their vital portion. No change is reported however in the rapid vision strategy. Revival of the White House's wartime map room—suggested last year in Nelson A. Rockefeller but vetoed by Soviet Union Secretary of State Herbert Hoover Jr.—apparently is not planned.

### Employment Brake Eased

Defense Secretary Neil H. McElroy said he must ease Sputnik I and II, is clearing the brake on civilian

employment ordered last July by his predecessor, Charles E. Wilson. The Wilson order blocking civilian defense hiring already has reduced the rolls by 68,193 employees or about 6% of the department's civilian strength. McElroy now said the services will be permitted to fill a limited number of civilian vacancies needed to sustain activities.

Best estimate is that at least 25,000 employees will be brought in.

### Submarine Defense

Sen Henry M. Jackson (D-Wash.) is doing advocacy of stronger Polaris-launching submarines for the U.S., in new charges that the Administration is ignoring the vital defense need of early warning and detection of enemy submarines/launched missiles. He said the missile threat from the sea is equally as great as the missile threat from the Russians had been. Jackson wants a massive U.S. fleet of 100 strong missile launching submarines.

### Shift in Blame

Rebuking an earlier stand that strikes are being forced to risk for a lost revenue because of too much competition, United Air Lines President W. A. Patterson last week chose to shift some of the blame for the decline of competition during the past two years from the Civil Aeronautics Board to congressional pressure. During hearings on the general passenger line situation, he added that it is no secret that this pressure was imposed by what became a discredited segment of the non-scheduled operators. Patterson indicted the airlines themselves as the cause of excessive competition by pointing out that large airlines sought and received new because of a liberal "philosophy." Several operators while smaller airlines sought new routes for expansion. Other also said to the pressure on the Board but, Patterson concluded, "the fact is, in according to these pressures and creating excessive competition, the Board has seriously affected the current and economic position of the airlines, large and small."

### 'Bailment' Opposition

House Military Operations Subcommittee has found little support thus far for the Air Force's proposed "bailment" program. Under the program, operational military aircraft would be placed in the transportation of passengers and cargo. Industry and government agencies have opposed the idea, but Air Force and Military Air Force personnel who are still to be heard.

Under the program, a commercial airline would operate for MATS Fairchild C-119s, for the transportation of passengers in the Pacific area. Another line would operate for MATS C-119s to ferry cargo over the Atlantic.

Industry opposition to the bailment program was proposed to affect the growing demand that MATS have over a larger share of its traffic to commercial carriers. Rep. Carl Albert (D-Calif.), subcommittee chairman, says military missions will take the stand next, followed by Air Force and MATS to complete the transportation of MATS and Defense airlift operations.

—Washington staff

# USAF, Army Divide Anti-Missile Task

## Three long-range radar sites planned by Air Force; Nike-Zeus gets nod over Convair-RCA Wizard.

Washington—Three long-range radar detection stations to be built by the Air Force as its part in the nation's planned defense against intercontinental ballistic missiles will be located in Alaska, Greenland and another foreign territory. They will cover all of Russia. One of two types of radar to be used in each site is the advanced, all-weather, long-range radar system known as Nike-Zeus (in Turkey to detect jet groups of Russian missiles (AW Nov. 14, p. 20).

Former press releases for the last few years will be to provide Strategic Air Command leaders with a 15 min. warning time.

Army's Nike-Zeus anti-missile missile system—chosen last week over the competitor USAF Wizard system—is not expected to be operational before October 1964—approximately four years after long-range detection sites become operational.

Defense Department's chief of the Air Force missile was given the go-ahead that also gave control of both the radar and the detection network to the new Advanced Research Projects Agency and made General Martin D. Dyer, USAF's Hqs. director of ARPA.

## McClure Outlines Program

Defense Secretary Neil McClure last month laid out the structure of Army and Air Force against the changes in a series of three explanations, concerning the reconnaissance, defense and the use of weapons development of ARPA. "It is a new program, one contrasting an agency development to demonstrate the feasibility of achieving an effective defense against the ICBM," he said. "It is to demonstrate research and development in the Convair Wizard system but contains 'a number of agency to concentrate in that part of its Wizard program that pertains to the radar and data handling aspects in checking its relationship to SAGE and other radar capabilities."

"Both systems are directed to strategy for the closest possible cooperation among contractors in that the electronic system to be developed is mutually compatible. No significant changes can be made in these programs without the specific approval of the Director of ARPA."

McClure also said the mission applied to development only and that radar and missile have not yet been assigned. Former Defense Secretary Charles E. Wilson ordered on Nov. 25, 1954, that

Army be responsible for point defense and USAF for area defense. Under his definition of that term, point defense included medium range missiles. The assigned air targets at strategic altitudes out to a horizontal range of the order of 100 nautical miles. Nike-Zeus' range is estimated to be between 200 and 300 mi.

## Anti-Missile Funding

Although ARPA apparently will have three control over continued development of USAF's detection system, funds included in the Fiscal 1955 request, annual budget request and the Fiscal 1956 budget apparently will screen in the Air Force account.

On the other hand, Nike-Zeus money apparently will be a part of the ARPA account, even though Army continues to do the work.

Three long-range radar sites will include Nike-Zeus radar similar to the ARPA-17 set in Turkey and Lincoln, Tex., plus tracking radar similar to the one now operational at Millstone Hill in Massachusetts (AW Nov. 25, p. 34).

These will be built in with Air Defense Command at Colorado Springs, Colo., and the central Nike-Zeus radar will, in turn, see three more radars—air warfare, operations and tracking—plus command guidance system.

## Stiever Tour

Washington—Senior Committee on Defense a major review of all Air Force missile research (AW Jan. 15, p. 26) last completed a tour of the Air Force and Development Command base and will begin a tour of the rest of the world.

Committee was chaired by USAF at the beginning of its tour. Sen. James H. Anderson, before he was named chairman of ARPA last August. It is reported to report to his committee in March.

Committee members were headed by Air Force leadership: ARPA's head, General and ARPA's Chief of Staff, Lt. Gen. Robert H. Anderson, before he was named chairman of ARPA last August. It is reported to report to his committee in March.

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Radar Corp. of America is prime contractor for the three in northern sites and will handle the other two sites. The Central Electric Co. will build much of the rest of the equipment, including antennas, pipe organ antenna feeds, etc., at its old in the 1950's.

William Electric, because of its experience in building the White Alice radar communications system, will handle communications system. A number of other subcontractors are involved. The White Alice radar system, built by Bell Telephone Laboratories, development, apparently was chosen because it is a better solution than the proposed Convair-RCA Wizard, although Wizard had considerably longer range and was technically more sophisticated.

Butlers will require extensive speed and accuracy, and actually anti-missile was also probably will protect only SAC bases.

## Nike-Zeus Range

Nike-Zeus surveillance radar has a 1,000 mi. range, over a large Lincoln, Tex., with mechanical feed return. It is the only radar in the system, which is to be built in the future, which will include radar ranging from the long-range radar, and radar ranging targets to local area acquisition radar.

Acquisition radar has a range of 600 mi. with radar return and a radar return. Acquisition radar will have several Nike-Zeus batteries assigned to it. Each battery would in turn have its own tracking radar and missile guidance system.

On assignment from surveillance radar, acquisition radar tracks the target long enough to give trajectory data which is fed into the tracking radar. The tracking radar is responsible for the system's ability to track the target.

Service radar and tracking radar are a part of the detection system, developed by the Defense Research Agency, called C-17. The system is designed to track the target from the radar's perspective and to track the target from the radar's perspective.

## Multi-Target Radar

Millstone Hill type of radar, developed by Lincoln Laboratory, and named for its operational site 30 mi. south of Boston, tracked both Soviet Sputniks after radio direction finding techniques were employed to establish contact with the target.

Millstone radar is on 84 ft. director parabolic reflector which can be rotated 360 deg. in azimuth and can be elevated from horizontal to zenith.

Radar is mounted on a 90 ft. tower, and extremely high power transmitters are made possible by specially designed klystron tubes receiving 10 ft. high.

Contract was by Gen. Donald L. Pitt, USAF Deputy Chief of Staff for Development before the House Defense Appropriations Subcommittee, indicates this will be two other experimental installations for the Millstone Hill type-site at Sakschewitz, Canada, to test effects of the system on radar reception and the effect of an undetected site.

Gen. Pitt also testified about a multi-target radar, the use of a condenser tube to be located at the radar site to protect launch and support. He said it is 75% complete.

# Supplemental Bill Passes First Hurdle

By Katherine Johnson

Washington—House Appropriations Committee last week approved a \$1.2 billion "annual anti-missile supplement" to the Fiscal 1956 budget, which is expected by the Administration under its post-Sputnik acceleration program. The committee stated that "in the critical area of space satellites and ballistic missiles, we are generally behind the USSR."

The funds, which under the pre-Sputnik plan would have been included in the Fiscal 1956 budget (AW Jan. 20, p. 25), will now be available for use during the remaining months of Fiscal 1955.

## More '59 Funds?

Then, after all these two developing months.

House Appropriations Committee members reported that Department of Defense has indicated that a new request for additional funds—over \$2 billion, the \$700 billion included in the Fiscal 1956 budget submitted to Congress (AW Jan. 20, p. 25)—will be requested shortly. The Subcommittee on the Armed Services headed by Rep. George Mahon (Calif., Rep.) expects to take this week on the Fiscal 1956 budget.

Group of key Democrats led by Sen. Henry Jackson (D-Wash.) worked on an expanded defense program which would add approximately \$1 billion to the \$381 billion program of the Administration.

The \$1,250 million supplemental, now up for Senate consideration, would include:

- Acceleration of the Atlas intercontinental ballistic missile operational capability, \$20 million.
- Acceleration of the operational cap-

ability of the Thor and Jupiter intermediate range ballistic missiles, \$170 million.

- Acceleration of the ballistic missile defense capability, \$160 million.
- Research and development in Army's Jupiter, \$20 million.
- Strategic Air Command alert facilities at 14 locations in the U.S., \$24 million.
- SAC, \$20 million.

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## Fund Transfers

The legislation authorizes these transfers of funds.

For financing of high-priority programs through the Fiscal 1956 program and the anti-missile missile program, \$100 million.

For immediate development of the Redstone, Jupiter, and Thor, \$100 million. The Redstone, \$20 million. For acceleration of the Lancer, \$10 million. Little John and Sergeant re-pro-

gram the installation of a ballistic missile with warning system. The bill authorized, "for the development of the high-powered transmitters necessary to obtain the long detection ranges (5000 miles or more) against the ballistic missile."

In September 1955, we had a breakthrough that made it technically possible for us to do this job—develop and construct the equipment necessary to obtain the long detection ranges (5000 miles or more) against the ballistic missile."

Subsequently, the House and Senate Appropriations Committees have moved the program and decided USAF could have a greater capability than originally planned and in the Senate, the program was moved to the House. The House and Senate Appropriations Committees have moved the program and decided USAF could have a greater capability than originally planned and in the Senate, the program was moved to the House. The House and Senate Appropriations Committees have moved the program and decided USAF could have a greater capability than originally planned and in the Senate, the program was moved to the House.

## Senate Appropriations Committee

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## Why Criticism

The criticism also told about the situation of the program.

USAF's top chief of staff, Gen. C. E. McClure, emphasized that these urgent programs were not provided for. He said production funds to maintain the launch and recovery systems from 11 to 14 years. He pointed out that there are no production funds for the Boeing B-52 in the regular Fiscal 1956 budget and that this could be a problem in the future. Gen. McClure stated that his testimony at a time and a half ago that Russia's long-range missiles could surpass that of the U.S. in mid-1959. He explained:

"A new look at the intelligence is that this probably does not up to the latest bombers a little bit. (However) this new second breaking news at another time announced results are even more of the Redstone, Thor, and Jupiter. It is a good thing that this country capability, will be used on."

McClure noted that "there is nothing

in the supplemental \$100 million further our knowledge of space technology. It funds were provided USARF now, he said, "we could come pretty close to a date of 1993" for reaching the Moon.

LeMay also called for increasing the number of bombers for Tactical Air Command and reconnaissance for Air Defense Command.

• **Additional \$20 million** would fund an additional \$30 million in the fiscal 1979 budget is needed to push the program for the Titan booster, which LeMay noted, "can be used in the advanced aircraft project this year" as well as serve the boost weapons system.

• **Additional \$52 million** is required immediately to adapt hardware to the North American USARF N-15 high-altitude research vehicle in connection with the space program, LeMay declared. He said that \$15 million in research funds and \$27 million in production funds should be added to the fiscal 1979 budget for the project.

• **To expedite the chemical bomber program**, LeMay said an additional \$10 million should be made available in research and \$31 million added to the fiscal 1979 budget.

• **USARF is short about \$200 million** in funds for electronics and communications (not equipment) and other nonresearch programs, he said.

Navy Secretary Thomas S. Gates made clear Navy's dissatisfaction with the elimination of funds for construction of a second nuclear-powered carrier in the fiscal 1979 program. "We have more

choices than intention in the 1960 budget of acquiring another nuclear-powered aircraft carrier," Gates added. "We have got to make in the 1979 budget for the long lead-time items."

Navy's industrial, too, apparently, coordination board report on the effectiveness of the nuclear submarine construction—see highlights in our detachments, the other emphasis in terms of shipyard making non-nuclear operations profitable.

On the vulnerability of submarines to atomic weapons, Navy reported:

"We can attack the submarine at sea with a high one-shot probability, of killing him and can so well attack him in home base with an equally high probability of destroying the support facilities necessary to his operation at sea."

The full radar increases with depth.

And increases with the weapon yield. "The important thing to note is that a high-speed, deep running submarine is vulnerable, and can easily be attacked with atomic depth bombs, and the deeper the goes to escape detection, the greater her vulnerability."

To measure her vulnerability to the effects of atomic weapons, the submarine must come to shallow depths which facilitates her detection. Also, the deep submerged submarine probably will not know she has been detected and attacked until it is too late."

Chief of Naval Operations Adm. Moyle Burke stressed "the transition" of the Polaris submarine as a weapon

in a world with no more destroying Russia noted. "It is only useful if it comes to tremendous warheads. You have to know what the target is. Although it is tremendously useful for a general war, as is a deterrent for the threatening of such a war, it will not do any good in any other situation. Even in a general war it will have limitations."

Burke complained that Navy has no equipment for its attack carriers but now has only 15. "Polars will do some of the things in a general war that a carrier can do, but not most of them, he added.

The second Navy report, on the other hand, declares:

"The modern submarine with greatly increased underwater speed and night vision, has recognized the anti-submarine problem more fully. The new offensive and entrepreneurial method of detecting the submarine is to destroy three lower bases, tracks and building work."

There, deployed near to the cutback of landfills, plus dispersed units not destroyed by strikes at source will constitute a viable threat to our own fleet of the sea.

This is a most difficult task, and with present capabilities can be accomplished only by attrition.

"The problem of aerial detection is the most difficult one in anti-submarine warfare. It is the one in which we have the best technology. This means it is subverted and the course is vast. We believe that the carrier is the most effective (anti-submarine) weapon system."

Defense Secretary Neil McElroy however was enthusiastic concerning the Polaris project. "Within the last month we have had a very hard look at what might be done to go all future in Polaris," he told the House Appropriations Committee. "This has been done in consultation with military supplies and in consultation with the national people."

He said that he might let us provide efforts to reconstruct an additional three nuclear-powered subs to be armed with Polars, instead of the new, new proposal. "McElroy said that the 'mission' of the new Polars (IRV) missile will be increased depth penetration in a second generation which will be a solid proposal of the general type of a lead-lined Polars."

#### Correction

Due to a typographical error, Article 1224, Week 40, page 75 of Jan. 15 issue incorrectly listed the total amount of an Air Force contract with General Dynamics of General Dynamics Corp. for investigating the use of new materials for a \$61,584,044. The figure should have been \$1,584,044.



Douglas MB-1 Genie air-to-air missile stowed in its stowed position on a McDonnell F-101B fighter jet.

## F-101B Carries Retractable-Finned, Air-to-Air MB-1 Genie



Genie is shown (above and below) mounted on a McDonnell F-101B. Genie's two retractable fins are shown in their stowed position so that it may be carried close to the fuselage. The retractable fins are shown in their extended position so that it may be carried close to the fuselage. The retractable fins are shown in their extended position so that it may be carried close to the fuselage.



## Soviets Test Jet VTOL

Soviet VTOL, called the Flying Stork or Tushet (Flying Stork) by the Russians, is shown during a recent flight over the USSR. The aircraft is shown in a steep climb, with the VTOL missile mounted under the wing. The aircraft is shown in a steep climb, with the VTOL missile mounted under the wing.



Douglas display of USAF Thor ICBM launching unit includes guidance support van, lower left; liquid oxygen tank, upper left; and auxiliary fuel tank at upper right. Note cone on Thor is a dummy, but the inert-operational cone cone can be seen on portable ladder at right. Thor is slated to launch position

and forward by long arm and hook extending from platform at the base of the missile. Thor engine is a 365,000 lb thrust Rocketdyne unit. First published picture of the display at Douglas' Coeur d'Alene, Idaho, plant was carried by Aviation Week in its Dec. 16 issue (p. 31, 32)

## Thor Displayed With Equipment, Warhead



Thor ICBM is shown above being loaded by crane into a Douglas C-124 Globemaster for delivery to Cape Canaveral, Fla., launch site.



Details of the USAF Douglas Thor intermediate range ballistic missile launching site at Cape Canaveral, Fla., are shown in the photos above, taken at a recent firing. Gantry crane has been pulled away from the stand which has adjoining building for test equipment. Other launching pads are visible through the smoke tent in the background. Below, a Thor on the same launching pad is shown in a different angle, through the solid rocket gantry crane.





# Missile, Aircraft Acceleration Asked

By Fred Eastman

Washington—Weapons now needed for U. S. defense and those required in the future can be developed and produced faster and in greater numbers, military and industry executives told the Senate Preparedness Subcommittee last week.

The subcommittee was told that production of manned bombers and interceptors, as well as ballistic missiles, could be increased to achieve the Strategic Air Command's demand peak which spans vehicles and other future weapons are being developed.

The witnesses testified that at least some reorganization of the U. S. defense establishment is needed in order to "get the job done."

Sen. Lyndon Johnson (D-Tex.) subcommittee chairman, listed 11 criticisms of the present defense machine which, he said, the witnesses blamed for the U. S. lag. They are:

- Too many committees
- Too many study groups
- Too many layers of authority
- Too many changes in programs
- Too little discipline allowed industry and military contracting efforts outside Washington
- Lack of funds
- Overwise restrictions imposed upon manufacturers
- Delays in budget procedure
- Too complex and decentralized organization within the Pentagon itself
- Confusion as to priorities on weapons orders
- Unwillingness to accept and act on the facts of Soviet military strength.

Gen. Nathan F. Twining, chairman of the Joint Chiefs of Staff, however, told the subcommittee that, "We are not at the dinner party now and are increasing our effort on sound programs which have been developed over the years we can protect the future."

## Twining Testifies

Gen. Twining and production figures of the Northrup B-1, the intercontinental ballistic missile, and Convair's B-15 supersonic bomber are good and that a decision to increase the number of Boeing B-52 Superfortresses under consideration, although there is no new money for this in the Fiscal 1970 budget requests.

Under questioning by subcommittee members, Gen. Twining testified that there had been no acceleration in B-52 or KC-135 jet tanker production since Sputnik II, and that plans of finding and testing a catalyst in Soviet production center.

He said the Air Force had wanted 500 additional jets for more B-52s, KC-135s and B-15s as well as an increase in RB-70s and F-4s.

## Industry Representatives

Industry representatives criticized the rate of production of weapons and said for more can be done now at relatively low cost than what is presently authorized. They included:

- Thomas G. Laughlin, Jr., vice president of General Dynamics, General Dynamics Corp. Laughlin charged that production of conventional bombers which will still be needed for years to

come, is being neglected because of "overemphasis" about reliability of ballistic missiles.

"Manned fighters and bombers and missiles associated with our defense today," he said, "are suffering for other reasons as the more glamorous ballistic missiles of tomorrow enjoy popular emphasis in the budget now being so reduced."

Laughlin told the subcommittee that



DONALD W. DOUGLAS, JR.

Convair could produce more rockets upon them it is now being asked to deliver and, in most instances, deliver them sooner. He added that the only acceleration of Convair program since Sputnik has been in the Atlas intercontinental ballistic missile and that the rate of increase here is far less than Convair's objectives.

Kraft Electric, Convair's chief planner for space and satellite development, directed told the committee that existing rockets should be used to put a communications, heavier satellite than Sputnik II into orbit and to launch a manned satellite. Nuclear rockets, he said, could be used to land on the Moon and put reconnaissance vehicles onto Mars and Venus.

William M. Allen, Boeing Airplane Co. president, Allen and Boeing could produce more defense weapons at a faster rate than now authorized. These include:

- KC-135-type transports at present time but could be accelerated.
- Bombers ground to air missile-could produce more and faster.
- B-52 bombers—phase out but begin and Boeing could be producing substantially more.

Allen also said he felt the present national income is insufficient to meet the increased spending necessary to passive peace and that the country should expect its income to rise.

Donald W. Douglas, Jr., Douglas Aircraft Co. board chairman (Douglas told the subcommittee he felt the Nike Zeus anti-missile warranted a go-ahead

which, two years ago that, but so far, a small fraction of the necessary funds has been made available. As to the flow intercontinental ballistic missile, Douglas and production could be accelerated to almost any degree which might be necessary.

Donald W. Douglas, Jr., Douglas president told the subcommittee U. S. missile capabilities are wholly inadequate. He said there is a four billion tonne deficit now and that in the event of an emergency, it could be used quickly.

Ray T. Harbo, Convair Wright Corp. president and board chairman, Harbo charged that the U. S. is spending money "for which we are getting too little, too late so far as defense is concerned." He said the Air Force is still being requested that was considered obsolete by Russian standards three years ago. Harbo said he was told at an Air Force meeting that, years ago that all but two types of power plants being purchased and built in the U. S. were obsolete by Russian standards.

To date," he said, "all procurement has been directed toward what we then stated to be obsolete and no program was put into effect for the two types considered superior."

Whitney C. Callan, Northrop Aircraft president told the subcommittee that if the Soviet subsonic guided missile had been ordered into production in 1955 the U. S. would have a weapon in operation which the present Navajo Deltacruise weapons could not stop.

J. H. Kniffenberger, board chairman of North American Aviation, testified that it will be several years before the U. S. has a completely reliable missile. He said it takes from two to three years to get the "bug" out of an airplane, but that because of their short flight time, it will take much longer to pass, test, analyze.

Kniffenberger said new facts being developed, such as Russian high speed weapons tested by North American's Rockwell, (Douglas said present) the use of smaller solid engines and substantially improve the thrust/weight ratio. The North American board said that was also predicted that several breakthroughs and innovations will still be in use by 1970.

## Rocket Firm Plans Gas Company Alliance

General Control Rocket Co., recently mentioned as a possible candidate for a company alliance (AW Jan 12, p. 14) says executives that one.

Though in a several agencies he notes his competition that keep getting bigger, General Control will enter a major interest in Transwestern Gas Transmission Co. of Houston in exchange for 50,000 shares of the latter's 1%



Atlas Integral Propellant Tank

Integral propellant tank, representing about 90% of the Convair Atlas intercontinental ballistic missile configuration, is shown in its test tank at Ft. Lee, Calif.

consolidate convertible around paid stock, according to a letter of intent signed last week by Transwestern Gas Transmission.

But the real significance of this consolidation, and General Control President C. E. Harbo, is that the enormous resources of Transwestern Gas Transmission will put General Control into a host line of major production of solid

propellants and solid rocket motors.

General Control wanted the merger because of the growing emphasis on big solid rockets and the large amounts needed to produce them. To get government contracts, a potential producer often has to prove that he can the financial resources to see them through.

General Control believes that its



KRAFT TRUCK, General's chief planner for space and satellite development, tells the Senate Preparedness Subcommittee existing rockets could launch manned satellites.





**GENERAL ELECTRIC CO.** proposal for turbopropelled first stage is shown separating from solid fuel ballistic missile (right) after carrying the weapon to great altitude and at speed of better than Mach 4. First stage then returns to the launching site (left) in one-pilot or after multiple air refueling. The reusable and self transporting nature of the self-launching boost equipment will reduce the cost of ballistic missile systems, according to company studies. Total orbit weight would be reduced because the first stage engine load is decreased by the turbojets which use the oxygen in the atmosphere.

## Turbojet May Serve as ICBM Booster

**COLUMBUS, Ohio**—Reusable turbojet powered first stage boosters for ballistic missiles and orbital rockets have been proposed by General Electric Co. to make current systems more economical.

Turbojet engines specified in the proposal would have about 15,000 lb thrust without afterburning and operate to Mach 4 and better. General Electric indicates they are the next logical step in turbojet development after engines such as the J79.

### Main Design Criteria

The company believes this will be no more difficult to develop than present day engines and that the necessary high temperature components can be built.

As the engines were not to be repaired to create the main design criteria would be to provide optimum operation in the regions around Mach 2 where engine performance is especially sensitive, to inlet and exhaust nozzle adjustment and vehicle drag is usually the highest. Good acceleration through this speed range is necessary if fuel load and total system weight are to be kept low. After a speed of Mach 3 or so is reached, the compressor and turbine would be

bypassed and the engine would operate as a ramjet.

The vehicle configuration shown here has been suggested by General Electric only to illustrate its concept and in the course of a development program the assumptions probably would change. Preliminary design studies have shown, however, that the weight of the turbojet booster for the first stage is estimated to be 50% of

ballistic weight. First stage fuel weight would be 10 to 15% of ballistic weight.

The Russians also are believed to be considering underdeveloped engines as a stage in large rocket systems so that part of the costlier load can be replaced by oxygen in the atmosphere. Russian slot, however, evidently tend to use of second stage concepts which are located quickly in speed in a first stage of solid fuel rockets. Reusable and quick reuse of such equipment would seem difficult.

### Primary Advantage

One primary advantage of the General Electric air-breathing boost system is that this can be flown in three stages. They would not require transportation or ground handling equipment, greatly facilitating missile dispersal.

Along with the company suggestion for air-breathing boost for more economical missile system, the Mach 4 turbojet is being pushed for manned aircraft. Turbojet experts are agreed that initial operation of this power plant now be extended to Mach 4 and better and that the variability of future research aircraft will make growth of this engine is not developed.



**POSSIBLE engine arrangement** would have two turbojets slanted at the rearward and two on outriggers for control.



## Radio Technique Tracked Sputnik During Final Disintegration Period

Columbus—Technique developed to track nuclear tests tracked Sputnik I during its two week period of disintegration until the fall of the last fragment according to records of Ohio State University's Radio Observatory here.

From the time that its 20 and 40 mc transmissions failed, Sputnik I was tracked by detection of signals from emitted on 18 mc by WWVU. National Bureau of Standards station near Washington, which were reflected from the ionosphere before generated in the satellite spot through the extremely data super strength.

After the observation has tracked both Sputnik I and II by reception of their televisual transmissions, and continuing to follow Sputnik II with the reflection technique, under direction of Prof. John D. Kraus. The reflection technique originally was developed for tracking nuclear tests by Prof. L. S. Wyke and H. T. Castle at Western Michigan College.

### Sputnik Timetable

Toward the end of December the estimated height of Sputnik I's orbit was about 180 mi, with perigee about 150 mi and apogee about 270 mi. During the time this period of ionosphere began to decrease rapidly, about 15 mi a day, and three fragments were detected in place of one. The timetable after that was:

- Jan. 4: Two of the three fragments showed signs of further breakup. Two fragments passed at the first and two fragments were eight minutes. This is the date given by the Soviet news agency. This for the fall of the satellite.
- Jan. 6: At least eight fragments were detected in orbit. Time between first and last fragments was 38 min.
- Jan. 7: Seven fragments detected.
- Jan. 8: Four fragments detected.
- Jan. 9: One fragment detected.
- Jan. 10: No signals observed.

Shortly after Sputnik I was launched, the observatory assembled a sample in the telescope for tracking the televisual signals on 20 and 40 mc. It consisted of two dipole antennas set up about 350 ft apart and an east-west line. The resulting pattern was a series of four shaped lobes running north and south.

In the vertical plane the two antennas added in phase to give a maximum, with other maxima at intervals of 60 deg in both directions. In addition to use of interference techniques, the satellite altitude was obtained from time of passage from one maximum to another and the period of revolution.

An unusual effect was noticed as the

satellite approached. The signals faded rapidly, and became very unstable until it reached a position where the angle between the line of sight and the orbit was approximately 60 deg. When the signals became unstable and faded.

One hypothesis is that the satellite swept up ionized particles in front of it or caused an ionosphere by collision.

### Reflection Method

Basic limitation of the reflection technique is that it operates only during hours when the 20 mc WWVU signal is not being reflected by the ionosphere to a significant extent. As the ionosphere rises in altitude at night, the electron density becomes lower with a consequent lowering of the upper reflected frequency level.

The strong reflections from nuclear ionosphere tests last for 2 to 3 sec, and the even stronger reflections from satellite ionosphere tests last from 1 to 2 min, which suggests a high degree of density.

At 5:55 A.M. on Jan. 4 the pilot of a Navy B-50, Marine Corp. Donald Perle, was passing behind televisual transmissions at Columbus Airport when he saw "a yellowish to orange object" that was very bright and traveling at great speed. It was also seen by another B-50 officer and a Navy technician accompanying him.

The object was in sight for 10 to 15 sec.

### Translation Plan

Washington—Communications Department has just announced plans for the establishment of a foreign televisual network program to compile and distribute information of available Soviet televisual broadcasts.

The program, similar to one proposed by U. S. senators (see page 34), is scheduled to "publish database" approximately 10,000 televisual and 10,000 complete translations annually including articles from "300 important Russian televisual programs."

During which he called the tower operator who saw it and entered it in his log. They noted that it appeared to form a disk and color was recorded. The time of sighting was later found to check with that of Sputnik I's passage.

Because observations do not become unambiguous upon leaving the object was not part of the satellite's orbit shell as merely was reflecting sunlight.

It could, however, have been a fragment of the re-entry structure.

Once a satellite has been located by a rocket or the plan purchased by reconnaissance testing it will designate fairly rapidly because of the "dumb-bell effect." This states that a dumb-bell shaped object that is tracking backwards is subjected to acceleration leaving the large axis will withstand heating better because they will be left in place to conduct it away. The small winging parts will disintegrate first because of its restricted conduction path.



### Fairchild VTOL Design

Airline's interest in an Army VTOL aircraft resulted in being developed by Fairchild. Designed the M214, the plane achieves maximum lift by means of a retractable slipstream. Initial flights are scheduled to take place later in 1955.





Genius 4 P100A is equipped with the most advanced electronic bus system and automatic

was developed for an Air Force helicopter.  
 Facility: Convair Division of General Dynamics.

The new "Delta Dart"...

**Fastest all-weather interceptor ever flown!**

Her Pratt & Whitney J-75 turbojet has been rated as the most powerful production engine in the free world. And it uses afterburning for extra power.

Nearest alloy pickoff for afternoon shift

Parr & Whitney picked Nimonics "75" nickel-chromium alloy for the afterburner shell of the J-75. This Inco Nickel Alloy provides the strength and corrosion resistance needed in this critical high temperature assembly. Nimonics "75" is also relatively easy to fabricate — an important factor in a product

### Time engine

If you're looking for a special alloy for high temperature operation, look over the list of Inco Nickel Alloys below. Among them are alloys with extra creep strength, extra toughness, extra oxidation resistance — properties that you may need. Inco's Mechanical Engineering Section will be happy to help you put your finger on the right one.

THE INTERNATIONAL NICKEL COMPANY, INC.

doi:10.1017/S0022292412001911

New York, N. Y.

<sup>2</sup> Measured in minutes.

Where Inco Nickel Alloys are used in jet aircraft

<b>Journal</b> Environmental Health Perspectives Vol. 100, No. 1 April 1992	<b>Journal</b> Risk Anal. Vol. 12, No. 1 February 1992	<b>Journal</b> Alkyls Comprehensive Chem. Vol. 1, No. 1 January 1992	<b>Journal</b> Lack Vol. 1, No. 1 January 1992	<b>Journal</b> Food Risk Vol. 1, No. 1 January 1992
<b>Journal</b> Environmental Health Perspectives Vol. 100, No. 1 April 1992	<b>Journal</b> Risk Anal. Vol. 12, No. 1 February 1992	<b>Journal</b> Alkyls Comprehensive Chem. Vol. 1, No. 1 January 1992	<b>Journal</b> Lack Vol. 1, No. 1 January 1992	<b>Journal</b> Food Risk Vol. 1, No. 1 January 1992
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## Decca to Be Evaluated For Helicopter Use

Boeing's low-frequency, high-altitude navigation system will be evaluated in a helicopter integration and test at the New York area, beginning around April. Aeronautics Modification Board announced last week. DoD proponents say the system's low-altitude and cruise-up and extreme accuracy make it ideally suited for helicopter operations.

Five representatives will participate in the evaluation.

- New York Airways helicopters will fly asthma drugs bag-potential chaperon—on scheduled flights.

\* Pacific Division of Beards Aviation will handle install and maintain equipment.

\* Arbonne Instruments Laboratory will provide cryogenic assistance and receive system performance.

• **Bell Helicopter Corp.** will install advanced instrumentation in a special Army-McDonnell Douglas test helicopter to be flown by AMHB pilots in evaluating feasibility of instrument

Approx. Migration Board Chairman E. B. Gonsky and selection of Brazil-Derco was made because of its immediate availability and does not represent an AMB endorsement over other hydrocarbon sources like Lanza-C and Incoch Radio Web.

### Unrealistic Scheduling Charged by CAB

Washington—Six domestic airlines were accused by the Civil Aeronautics Board's Office of Compliance last week with failing to operate flights in accord with published schedules.

In issuing the complaints, the compliance officer bypassed the Board's highly controversial "voluntary self-regulation" (AW Jan 33, p 43) and moved to enforce 411 of the Civil Aeronautics Act covering "unfair and deceptive practices." The airlines involved in related complaints are American Capital Delta, National Lines World and United Air Lines.

The complaints changed the current path 'filing and publishing schedules which are not reasonable, accurate and do not bear a realistic relationship to actual performance, therefore'.

Complaints were based on tests conducted by the Office of Compliance during the months of Feb. 1986, and April 1987. Tests on American's lights covered total in-cabin operations and checked that the percentage of lights operated under or on scheduled time ranged from 6.4% to 70.8% on job, and from 16.6% to 43.3% on land.

The amended Warsaw regulation, which went into effect in September and is under attack from the airlines, makes it a criminal offence to fail to specify flights within 15 minutes of published schedules at least 75% of the time.

Capital's flights were tested over two one-way trips of its routes between Chicago-Milwaukee and Washington-Norfolk. Completion of flights on schedule ranged from two times at all on one Viscount flight during the July tests to 42.8% on another flight. In April the same was true from 3.8% to

26.9% on 15 flights.  
 Dealer's average rate: (26.9%)  
 26.9% for fish car: (26.9%)  
 26.9% for fish car: (26.9%)

On National's designated flights, the range was from no trees to 5 in both months to 6.5% in July and 12.5% in August.

TWA transcontinental flights climbed disclosed that no fare optima have ranged from 1.1% to 20% in July and from 16.2% to 16.6% in April. United's flights rose from 26.6% to 16.6% in July and from 34.4% to 33.3% in April.



## Breguet Transport Tearing Americas

**Boeing** French aircraft manufacturer, is attempting to sell the **Breguet D550** (double decker) cargo transport to the Americans through a U.S. firm, Teo France, Inc., of Miami. Dornier first flew in 1951, can carry a payload of 35,000 to 40,000 lbs. over range lengths of 1,200 to 1,800 km. This model can fly at 40,000 ft. from 10,000, cruise on 157 passages, carry 18 people in 100 lbs. An Air France order for 20 D550s was cancelled in 1975, but the aircraft is still in use by the airline. The aircraft cost \$4.3 million. French Air Force has ordered 15 additional D550s purchased by FORT in 1976. The **B250C** B747 developed 2,500 hp each. This version, being offered to American buyers has a marked performance improvement at altitude. Sales price is \$155 million without fuel per year. Fines, Breguet held Aviation West that his company's agreement with the French Air Force is feasible enough to allow him to offer second position on the 15 plane production line to prospective customers. Breguet, Paris has traded New York, New York said Miami, and will visit Dallas, Reno, Las Vegas, Boston and New York.

# BOAC Views Britannia as Money Maker

By Glenn Gardner

New York-British Overseas Airways Corp. believes its Bristol Britannia will yield three times the first year's all-turbine competition, and that the turbojet Britannia can perform a useful job for the airline for at least 16 years.

BOAC began transatlantic Britannia service last December with a modest once-weekly round trip schedule, is also operating a series of possum flights as the airline tries to cover and feel out the performance of the long-range Britannia 312 on the Atlantic run.

The British carrier has been flying its medium-range Britannia 312s in scheduled Africa, Australia and Far Eastern service since last February. Transatlantic service on the 312s will be stepped up this spring as additional planes are delivered. The plane is scheduled to serve San Francisco, Montreal, Detroit and Chicago this year in addition to New York.

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in constant altitude of 24,000 ft under high speed cruise conditions. Time was 7 hr, 18 min, just two minutes over the phased flight time.

At the same altitude, the plane's time was 7 hr, 18 min, just two minutes over the phased flight time.

Long range cruise technique with the Britannia involves step climbs of usually 2,000 ft each, in fact a gradual climb and speed builds up to VNO (maximum normal operating speed) at 24,000 ft with standard outside air temperature, the VNO true air speed of the plane is around 140 kt.

A big difference in operating the turbine-powered Britannia is the more than practical altitude of about 20,000 ft. Fuel consumption jumps sharply at these altitudes and VNO is lower.

Between London and New York, with 100 kt headwinds at 20,000 ft, a Douglas DC-7C could go down to 10,000 ft and employ long-range cruise against perhaps a 45 kt wind. The Britannia, however, would have to remain at high altitude and bank the wind.

BOAC's weekend scheduled flights on the 312s have been able to make it nearly to every one but one. In that instance, the flight encountered 100 kt winds between London and Gander and 170 kt winds between Gander and Boston.

Although the drought jet Vickers VC-10 now replaces BOAC's Britannia on the LAX-JFK route, the airline is thinking in terms of at least a dual use of the service with the turbo-jets.

"Our view about this airplane is that it's a very sound piece of transportation," K. G. Gardner, BOAC's chief executive director, told Aviation Week. "We feel that it can more than hold its own against the big jet during the first few introduction years."

Temporary Advantages

One temporary advantage for the Britannia is the fact that the carrier's fleet is the largest fleet of medium-range turboprop aircraft in the world. This gives the carrier a significant advantage in the short-haul market.

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## Now flying—the new multi-mission Lockheed **JETSTAR**

—the answer to the urgent need for a jet utility trainer-transport.

Designed for a variety of Jet Age military missions, the Lockheed JETSTAR is a utility jet transport that flies 500-550 mph, at altitudes up to 45,000 feet for distances of 1,600 statute miles or more.

Amazingly quiet (due to aft fuselage housing of engine jet pods) the new JETSTAR will be powered with two Wright T37 engines—or with four General Electric J85's or Pratt & Whitney J85's.

The JETSTAR carries a full complement of radio and navigation gear and is fully pressurized and air conditioned.

Like all Lockheed planes, the new JETSTAR is easy to maintain and economical to operate. And it has the inherent stamina to insure optimum utilization and long life—qualities that are more important in military aircraft today than ever before.

**LOCKHEED means leadership**

Lockheed Division, Lockheed Aircraft Corporation, Marietta, Georgia

any place BOMAC has operated. It replaced Lockheed 749 Constellation and Argonaut on the routes.

Load factors on the 102 route, according to Gamble, have stepped up 1 to 3% since introduction of the Britannia to about 65% a week, and this are moving about the same percentage over the competition, chiefly 749 Constellations and DC-7Cs. "We're not running away with all the business," Gamble said, but are making progress with it.

He explains an average transatlantic load factor of 85% with the Britannia. The 162s are operated entirely in mixed configuration with 24 first class

and 48 second seats. Passenger coaches in both classes had been considerably good, Gamble said, and BOMAC's new seats affected passenger confidence to last degree. The airline has 15 Britannia 162s in its fleet, a 102 aircraft a total of 18 of the 317 seats.

BOMAC's present weekly transatlantic service is a first class flight with 24 seats and 24 standard seats plus 15 berths. Scheduled time is 8 hr, 30 min eastbound and 12 hr westbound, but BOMAC is considering having three consecutive schedules and they may be reduced.

The airline plans daily peak service

between services that will cover its London-New York-San Francisco and London-Montreal-Detroit-Chicago routes. These flights will all be in a mixed configuration with 34 economy seats, two and three-above, 15 non-berth standard first class seats and 12 de luxe berth-class seats.

Later on, since 112s will go into London-Johannesburg service, replacing 102s which will be shifted to Australia and Far Eastern routes to build frequency on those routes.

#### Light Loads So Far

Loads on the transatlantic service, which opened London to Freetown and New York on Scotland, have been fairly light so far, according to BOMAC. The airline has not yet received the transatlantic service through yet in its advertising.

The highway service is presently a very small part of the total transatlantic capacity of the airline. A Protone engine window, despite its BOMAC's fifth service since late last year, has not met the airline's hopes. It is being re-evaluated, and advertising will be reduced in frequency or stopped.

Delays in delivery of BOMAC's 112s in its Britannia program from the manufacturer of both the engine and the engine training. For the long-range airplanes had been delivered by the middle of January. The airline has made some modifications on the Atlantic on proving flights and has indicated 112 equipment will provide U.S. cities on training routes.

The Britannia, like the Viscount, operates from Idlewild under normal air traffic control handling. Only an engine on an incoming day has taken off. When there is delay and a line waiting to take off, the turbine pilots are asked to be taken they will be able to get off and wait on the ramp until peak hours that time.

## Trans-Canada Plans Added Europe Service

Trans-Canada Airlines will start additional services to five more European countries in April and May, according to a report made in the Canadian Press by the Transport Minister George Birt.

TCA in April will start service between Canada and Belgium, with a stop at Brussels on the Montreal-Dusseldorf route. Early in May, TCA starts service to Switzerland, stopping at Zurich on the Toronto-Montreal-Paris service.

Now also said that Canadian Pacific Airlines will make a stop at Edmonton on its pilot service between Vancouver and Detroit. Until now, passengers to and from Edmonton have made CPA connections at the gold mining town of Yellowknife in the Northwest Territories.

## SHORTLINES

**Air Transport** Ann reports airline business transactions conducted through the Airline Clearing House in November showed an 8.14% increase over those for the same month of 1956. Total airline business in November was \$62,751,708.34 compared with \$58,004,600.91 in November, 1956.

**American Airlines** will give a dividend of 25 cents per common share in March to holders of record as of Feb. 15. Airline's board of directors also declared a regular quarterly dividend of 57.5 cents per share on 1450 shares. Dividend payable preferred stock will be March 1 to stockholders of record at close of business Feb. 15.

**Hawaiian Airlines** reports it carried 453,785 revenue passengers during 1957, equivalent to a 10% increase over airline population of the Territory of Hawaii. Hawaiian firms the passenger 61,820,000 passenger-miles, a 4.9% increase over 1956. It also flew about 78 million lb of air cargo in 1957, a 3% increase over 1956.

**Midwest Airlines** reports that it carried 31,065 revenue passengers 5,721,914 revenue passenger-miles during December. The figures represent 27.1% and 24.4% increase respectively over December, 1956. Midwest also carried 76,755 lb of air mail and 23,412 lb of first class mail, 133,560 lb of express and 165,730 lb of air freight during the month. Preliminary figures for 1957 indicate that Midwest flew 428,564 passengers approximately 30 million passenger-miles on an increase of 18.9% and 24.7% respectively over the previous year.

**Trans-Texas Airways** carried 15,487 revenue passengers 4,431,000 passenger-miles during December, the last full month of the year. December figures for Trans-Texas were 12.1% and 12.1% respectively above those of November. Trans-Texas' record for passengers approximately 743,791 passenger-miles, approximately 35,000,000 passenger-miles.

**West Coast Airlines'** new Fairchild F-27 transports to be placed in service as end-of-year will carry passengers for the first time in the company's history. West Coast has been using male flight attendants because of frequent short-stopping landing of mail freight and baggage. The airline's first new-line training class will begin in a few weeks with graduation scheduled in March.

## AIRLINE OBSERVER

**Winds** for a compromise move by Congress, placing the rate increase for first-class mail at four cents rather than the five cents sought by the Administration. Congress also may decide to have the rate used by air on both transatlantic and local service routes by waiting that all first-class mail be transported by the most expeditious means.

**Airlines** for the recently adopted Civil Aeronautics Board regulation covering depreciation practices on airplanes and engines will have a determining effect on investment programs. They claim that replacement of passenger aircraft is an important factor in the purchase of jet transports, adding that time increases for retirement being widely among individual airlines. For example, American Airlines will retire its DC-7s in 1961 because the aircraft will lose its competitive power in its markets after that date. Another major carrier feels its DC-7s will compete effectively until 1965 and has chosen that date as a retirement target. Regulations, which became effective Jan. 1, call for a straight-line method of depreciation and a severance fee with a 15% residual value. Air Transport Ass. has appealed the ruling to the Circuit Court of Appeals.

**Airline stocks** are showing new strength in the New York Stock Exchange and performance near the first of the year has brought steady advances compared to the virtual standstill that held prices during the latter quarter of 1957 due to the year's loss. Capital and Eastern have registered the biggest gains for 1958 thus far.

**Italy's Zappata A-2A** four-engine DC-3 replacement is nearing completion and is expected to fly by the end of next month. Plane carries up to 26 passengers, is powered with four British Avon Leonides 502.5 engines rated at 540 hp. each for takeoff. Wingspan is 54 ft. Quoted design operating cost are about 35 cents per hour standard rate at most economical stage lengths, 375 to 500 standard miles.

**Local service airline** interest in pooling resources for the maintenance and overhaul of the Pratt & Whitney engine that powers the Fairchild F-27 transport is beginning to take shape. Strong possibility now exists that most local service carriers will contract with Capital and Commercial airlines to handle engine overhaul facilities. Continental is meeting delivery on the first Fairchild Viscount this spring, and the first F-27 deliveries will begin shortly thereafter.

**Northwest Airlines** suggested public telephone system installed in the rear of the passenger cabin of a Boeing 377 Stratoliner has become so popular with passengers that it is a constant use for long-distance calls during flights. Northwest's unit is one of six provided by the American Telephone and Telegraph Co. to check operating efficiency and public reaction to the airborne service. Other units have been installed in private and business planes (see page 90).

**Carl Aeronautics Administration** has let a contract to Johnson Electric Products Inc. for the purchase of 31 complete overhead baggage storage slaking light to install and associated equipment. Thirty of the systems will be installed at U.S. airports but one was procured for shipment to Brazil under an International Cooperation Administration program. Sequence slaking systems are presently in operation at Newark, Cincinnati, New York, Idlewild Airport, Boston and Los Angeles.

**One direct result of airline economy** drives to flight doubling expense levels has been a sudden bid in the expansion of city ticket and sales offices, particularly in off-hour cities. Activity in this field declined to a virtual standstill last year after several years of steady growth in the number of direct and local ticket offices in a disproportionate rise in domestic passenger traffic.

**American Airlines, British Airways and KLM** have contracted with Hamilton and Co. Engineering Co. for industrial vehicles for the line's seats for their Lockheed Electras. Hamilton is producing all the lounge configurations on the Electras.

### NOTABLE ACHIEVEMENTS IN WIND TUNNEL TESTING—NO. 3

CWT engineers are a dedicated group, spending many extra-man-hour hours in the pursuit of basic scientific information. The result of a recent test is shown below.



## Equipped For Action

For aerodynamic testing and development, CWT's engineers have at their command one of the nation's finest wind tunnel facilities.

For example, CWT engineers utilize three interchangeable test cells, high speed on-line computing systems, and a new aerodynamic pressure data recording system. Facilities such as these, in combination with a skilled and versatile staff, have helped the CWT build a reputation for quality and efficiency known throughout the world.

In addition to its owner companies, the CWT also serves other leading aircraft firms and government agencies.

If you would like more information concerning the facility, please write us.

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SOUTHERN  
CALIFORNIA  
COOPERATIVE  
WIND  
TUNNEL

Operated by the  
California Institute of  
Technology—Owned  
by Convair, Douglas,  
Lockheed, McDonnell  
and North American.

910 E. Raymond Ave., Pasadena, California



**SEA DUTY**—Largest helicopter ever operated from an aircraft carrier is the twin-engine Marine Corps HH-51B (Sikorsky S-56), shown here landing aboard the carrier *Valley Forge*. Sikorsky HRS and HSS helicopters, saving veterans on a variety of Navy and Marine Corps missions, also flew from the carrier during recent fleet maneuvers off Guantanamo Bay, Cuba.

## AROUND THE WORLD WITH SIKORSKY HELICOPTERS



**MISSILE MOVER**—Army tests have demonstrated the ability of the big H-37 (S-56 type) to transport missiles, launchers, and support equipment as well as vehicles and other cargo. Here it salutes an H-6000 John made. The H-37 normally carries 36 combat troops or about 3 tons of cargo.



**FOR EMERGENCIES**—Chance Vought Aircraft will use this Sikorsky S-56 for supporting the company's fight program and for search, rescue, and salvage duties. The S-56 will also be available in the Dallas area for disaster relief and other public services, and will transport high priority passengers and cargo.



### HELICOPTER HISTORY



**FIRST MAJOR PUBLIC HEALTH PROJECT**  
In May, 1951, the government of Belgium Congo assigned the task of these S-56s to be used in aerial spraying to kill insect-breeding insects. Since then helicopters have flown many times over native villages like this shown here as well as over Leopoldville, helping stamp out malaria, sleeping sickness, and other diseases.

**SPEEDING POWER LINE CONSTRUCTION**—The Southern California Edison Company has erected high-voltage transmission lines more quickly using a Sikorsky S-56 helicopter to carry structural steel and other materials direct to tower sites in rugged terrain. The utility company's lines cross mountainous areas where surface transportation cannot operate efficiently. The big S-56, shown here installing a 50-foot pole, can carry two tons of cargo and raise it wherever needed.



**SIKORSKY AIRCRAFT**

STRAFORD, CONNECTICUT

One of the Divisions of United Aircraft Corporation





Bomarc IM-99 missile shown (right) in midst of firing, leaves launching shelter propelled (left) by rocket, with capsule sinking. Missiles can be fired in salvo and directed to individual targets while in flight.



First production Bomarc rolls out, while four more take shape in background.

## Air Force Orders 100 Bomarc IM-99s

Boeing will produce approximately 100 Bomarc IM-99s and defense supplier and supporting ground equipment under Air Force production letter contract. Only two second lot type-1 models of the rocket-propelled missile for which \$12.9 million of Fiscal 1957 funds were authorized. Evaluation under new contract would be finished from Fiscal 1958 funds. Bomarc is 37 ft long, has 25 ft wingspan, weighs 15,000 lb. Ceiling is above 60,000 ft, altitude from which it is launched IM-99 has a range 8-17 at a distance of more than 100 mi. First lot of four tactical Bomarc units will be Dow AFB, Mo.; McGuire AFB, N. J.; Otis AFB, Va.; and Sullis County AFB, N. C. About 100 of the work on Bomarc will be subcontracted.



# MISSILE ENGINEERING

## USAF School Simulates Living in Space

By Cong Lewis

San Antonio—As manned flight goes further, more higher in the atmosphere and beyond into free space, vital questions arise concerning human adaptation to those strappings, new flight environments. Some of the answers to these questions hinge on space medicine research being done here at Randolph AFB and in other U. S. laboratories.

Manned flight capabilities already have reached levels into the space equivalent zones of the atmosphere, and the firing of human satellites into orbit clearly demonstrates the potential for manned flight into free space in the next decade.

To find out as much as possible about the effects of this new environment on human pilots and passengers and to determine what man must do to persevere life in these regions, the Air Force's space medicine experts are currently conducting a program of basic research in four fields here at the School of Aviation Medicine.

•Space cabin simulation in which subjects are sealed for various time periods in a simulated space environment as well as isolated craft.

•Psychological testing done on subjects in space cabin simulators shows degrees of vigilance, discrimination, judgment and other factors during extended periods of isolation in simulated space environment.

•Flight progress providing brief periods of weightlessness provides knowledge of the new conditions with which space travelers will have to cope.

•Experiment with glider-simulation prior to possibility of man alone in areas of absorbing trade routes, discrete and producing progress in relative sailing extended flights in space.

### Free Space Approach

Man already has made brief forays into zones of the atmosphere which are partially equivalent to free space in vehicles such as the Bell X-1 rocket airplane (AW Dec. 23, p. 45) and the balloon, which carried Maj David Sasser to 107,000 ft (AW Aug. 26, p. 31). Next major step in the North American X-15 which will be set in area where the atmosphere is so thin that it is equivalent to free space, for all practical purposes.

The X-15 is the next step in a manned satellite, and Dr. Herbert Straghold, advisor on research in the

space medicine program here, describes the various positions of flight in the upper regions as to a "ladder of atmospheric stages." It is a transition between the familiar atmosphere flight and the space equivalent and free space environments of satellite flight and later lunar and interplanetary flight in free space.

Dr. Straghold points out that the boundaries, he is not yet named, will be flight in the vacuum of the vacuum. But the engineer needs medical advice to determine what level of altitude a man can live and work in, and Dr. Straghold says that space medicine is prepared right now to give engineers the necessary advice and human requirements for space travel.

### Ground Study

Researchers here, too, elsewhere are studying the effects of such things as stress, on bombardments, the lack of space, weightlessness and other factors which can be studied on or near the Earth.

Dr. Straghold feels that all elements of the problem that can be researched on the ground are now under study, although he points out that not all studies are complete. Some factors, such as the effects of extended periods of weightlessness, can only be studied in space.

An important element in the design of a manned satellite is the fact that the man must retain his health. Thus, the satellite must not only solve the problem of keeping its passengers alive and functioning but it must provide means of restoring the atmosphere and recharging the passenger's life. In the ground, the medical aspects of the equipment are studied.

A kind of prototype for a manned satellite exists now at Randolph AFB in the form of a space cabin simulator. It looks like a small furnace covered with a mesh of plumbing and has no windows, to actual satellite hardware. But the environment produced inside the simulator is the same kind of environment the satellite or space ship will have to provide its passengers.

This simulator is a hermetically sealed cabin that supplies its own oxygen, disposes of waste products and supplies water. It's not a man who is sealed alone begins with the work of Auguste Perard in 1931, and balloon gondolas have used the principle down to Maj. Sasser's recent flight. But this cabin permits detailed studies of the



VOLUNTEER subject A2C Fred W. Childers sits in space cabin simulator at USAF School of Aviation Medicine to demonstrate cramped quarters, isolation in prototype of studies of space flight conditions.

effect of its environment on its passengers.

The cabin provides about 100 cu ft of space. It is not high enough for a man of normal height to stand up in and the possibilities for exercise are very limited. The subject sits in a cage for several days and has a period of flight, watches and displays which are used to test his psychological reactions to confinement.

### Drinking Water

The cabin is capable of recycling water to provide drinking water. Moreover, it takes care of the air and carbon dioxide, and waste can be handled for drinking purposes. Indicators are working on a means of recovering other human waste. Subject will be provided with normal in-flight menus, and the cabin is fitted with a food warmer.

Oxygen is supplied from external tanks and bladders circulate cabin air through hydroxide carbon dioxide absorbent. An activated charcoal absorption system is used to handle the carbon problem, although it is relatively recent.

Temperature and humidity levels are controlled through an air conditioner and a heater and a vaporizer. This equipment is jiggled in an effort to find the ideal combination of temperature and



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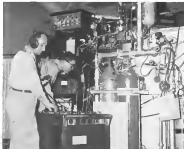
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LT COL George K. Stewman (left) and Capt. John Ward conduct simulation while equipment is connected in the space altitude simulator.

altitude and to determine the range within which a man can work efficiently and live comfortably.

### Tolerable Altitude Sought

Medical men would like to have the space traveler live in an atmosphere similar to sea level conditions, but the oxygen tank at this end went to lower the pressure differential to solve that problem. So engineers in the simulator are attempting to determine the highest space altitude man can tolerate. It is probably somewhere between 35,000 and 35,000 ft.

During these experiments, the subject doesn't wear an oxygen mask, although one is provided for emergency.

A number of short flights have been made in the simulator, but the most successful so far was a 24 hr exposure made at an equivalent altitude of 15,000 ft. Various factors are monitored in these flights, including the subject's heart action and respiratory rate. Emphysema is recorded at the different points with thermocouples.

### Emergency Precautions

A medical officer and a technician sit on duty throughout the run, and the simulator has an alarm system for use in emergency. That is the an astronaut must be emergency use or in case a subject should want to leave before the experiment is complete.

A new, larger space altitude simulator is planned to accommodate two men. It will be a modular design which will be expandable, and researchers are hoping it will be ready when the School

of Aviation Medicine moves to new quarters at Brooks AFB about a year from now.

Experiments will continue with various altitude levels to find the best oxygen pressure. As cabin altitude is increased, oxygen pressure is kept at ground level so that the subject's atmospheric gas up the properties of oxygen increase.

The simulator has been moved to new quarters at Randolph AFB, and some of its equipment now is being overhauled. When it is back in working order, the next big step will be a one-week flight planned for February or March.

### Psychological Problems

According to Capt. John Ward, one of the medical officers working with the simulator, the longer flights probably will produce less psychological problems. He feels the psychological problems of a subject completely isolated for a week are liable to be somewhat more serious.

In these experiments a subject is taken out of his normal working condition and put in an abnormal, cramped position. The psychologists want to find out how this change affects a man's normal performance curve.

A big tool in this work is a testing console which has been in use for about two months. It presents a battery of lights, dials, buttons and switches to the subject in the cabin. Problems can be set up on the console to test effects of the environment on the subject as the flight progresses.

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require repairs to indicate on the console and will require recognition of error. Response time can be measured to determine the degree of vigilance.

Subject's discriminatory power is measured by requiring him to choose the proper solution to an emergency situation. For instance, he will have to react to different combinations of warning lights by flipping the proper switch.

Judgment is tested by comparing displays. The console has a static display and a dynamic radio display. The pattern on the dynamic display is in motion, and at one point will match the static display pattern. The subject must judge when the two match and signal with a switch.

Tests will use a random distribution of events lasting about 10 to 15 hours, most of them unannounced.

### Problem Solving

Problem solving proficiency is assessed by measuring how quickly and accurately the subject responds to, to a problem of extraordinary lights with a set of switches. He has to figure out a logical sequence of actions. The rules remain constant from problem to problem, but the solutions of switch to light change.

These tests will indicate how long-term commitment and solutions will af-

fect proficiency in these four areas. They also will show how the subject's proficiency reacts to changes in the person's environment. Changes of carbon dioxide and oxygen can be regulated for work in this area.

Another factor which interests psychologists is the effect of saturation on an extended period. Fatigue studies have shown that some people differ in level of performance under the effects of fatigue, and this factor is important in determining the best diet for the subject in terms of performance and maintenance of efficiency.

### Fatigue Factor

Fatigue is also a factor in setting the day-night cycle in this artificial mission test. Research will have to determine how the work and rest period should be distributed to maintain performance. Previous experiments have determined that the length of the day cycle can be changed, but now the task is to find out how much it can be shortened or lengthened.

On a hypothetical day-night cycle with a three hour rest, cycling would have to be arranged so there would be a highly reliable rest available at all times. Work-rest cycles would have to provide a uniform high level of performance over an 24-hr period.

Tests of the effects of fatigue on per-



CARBON DIOXIDE added by man in sealed chamber is released from the chamber and circulated through a closed loop in background. In this test the subject is exposed to fluorescent light and receives the carbon dioxide into lungs through the process of photosynthesis. Oxygen is then recycled into the chamber keeping the man alert.

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MAJ. HERBERT D. Stollery, Jr. (left), and Dr. Stephen J. Gottlieb stand by Lockheed F-94C which is equipped with windows and domes for infrared weightlessness.

transmits outside the window has indicated cycles of maximum efficiency over long periods and dissipated the effects of overexposure such as dizziness, nausea, vomiting, vertigo, and headache.

### Optimum Cycles Vary

It has been found that optimum cycles depend on the task involved and on light intensity. It has also been determined that there are window relationships which prevent fatigue and deterioration of personnel.

Once the best window cycle is determined, it probably will be necessary to change and rotate the cycles at the zero position, before taking off, and will be adjusted to the new regime. There was no daylight here to indicate sleep and a schedule in regulating the cycles.

Dr. George T. Harts, who is in charge of preflight testing, points out that initial space flight programs probably will have the advantage of using highly motivated, drilled people such as the group living at Edwards AFB.

Still, a certain amount of screening will be needed to determine which people would be best suited to space flight conditions to test their reactions to such phenomena as weightlessness.

### Weightlessness Effects

The question of the effect of weightlessness on men flying through space is one of the major unknowns in space flight, but work done here in zero-gravity experiments has developed a new, if somewhat limited, body of knowledge on this condition.

Weightlessness is not experienced

for extended brief periods with some of the aircraft now flown in the atmosphere when they are in a zero-gravity condition. The period of weightlessness now will increase in space flights with the X-15 capsules. A manned satellite will be in a prolonged state of weightlessness since no disturbance of orbital flight is the fact that centrifugal forces balance the Earth's gravitational pull.

The true test of human reaction to weightlessness will not come until a man is exposed to an extended period of it, but some valuable data on the effects of short periods of weightlessness have been gathered here in a flight program opening next 1955.

### Weightlessness Induced

Spun, rocket-accelerated have been able to induce weightlessness for periods of up to 45 sec. and findings so far indicate that this condition presents no bar to manned flight in space.

Brief periods of weightlessness have been induced in a flight program employing Lockheed's T-33 and T-94C aircraft. Since weightlessness is a function of speed and trajectory and is produced by the equilibrium of centrifugal force and gravity, the zero-gravity state is achieved by flying the jet parallel to a Keplerian trajectory. The condition occurs when the aircraft is describing a parabolic arc.

After some experimentation with various altitudes and maneuvers, researchers decided that 20,000 ft. was the proper altitude to use in the experiments. A T-33 was the first aircraft assigned to the program, and it was used for about eight months. A wide variety of subjects were trained in the test seat.

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So long as there is the problem of maintaining tubular shapes, formed and welded rings will be important components. For all we've read, men had heard about multi-joint missiles, they said their engines are - and for the foreseeable future, still be - tubular shapes. It follows that there will be an increasing demand for the kind of rings King forms most widely at New Britain.

King has been here not been forming whole tubular shapes. The area services here done a considerable job considering the lack of intensive leadership. He says sincerely that, under the new program, our ballistics missiles can and will get off the ground to perform their appointed tasks.

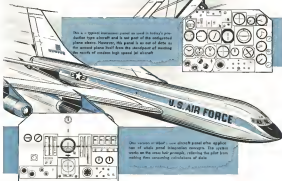
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## BREAKING HUMAN BARRIERS TO JET-AGE FLIGHT

The main bottleneck to safe and effective pilot control of super-sonic aircraft results from the complexity of cockpit panel instruments used to display flight information. The Cook Research Laboratories Division of Cook Electric Company is now launching the U. S. Air Force in developing new displays and controls that show more in less time. This CONTROL-DISPLAY INTEGRATION PROGRAM is directed by the Flight Control Laboratory of Wright Air Development Center.



This is a typical instrument panel as used in today's pre-1950 type aircraft and is too poor of the integrated plane above. However, this panel is so out of date as the second panel itself from the standpoint of meeting the needs of modern high speed jet aircraft.

This version of integrated cockpit panel also applies use of whole panel integration concepts. The system works as the crew looks through, viewing the pilot from within the cockpit, combining information of data.

The objective of the whole panel program is to eliminate as much as 30% of the mass of instruments and dials that a pilot must use, and provide more information in an easier to use form. This new panel concept has resulted in a simplified design using the cross-hair principle. In this case, however, the vertical and horizontal cross-hairs are not fixed but are made up of many small segments by means of moving tapes. In normal operation the cross-hairs appear intact. Any deviation of the segments, however small, can

readily be seen by the pilot who then knows instantly that a correction is necessary. The break in the line tells him what to do to get the segment back in line. All this can be done instantly without having to read, integrate, or perform conversions of flight data as now required. Cook Research Laboratories take pride in being able to participate in the all important program of increasing the safety and effectiveness of modern aircraft both for general flight and missile accomplishment.

to test these systems to the next possible state.

The test flight in the T-33 began at 20,000 ft. A sharp dive was started with 5657 engine rpm and an AAS (indicated Air Speed) built up to 310 kt. The aircraft finally reached 17,100 ft. At this point, a 30 percent AAS was reached and the aircraft was put into a climb at about 60 deg. When AAS dropped to 300 kt, the parabola was started. The T-33 reached the top of the parabola at about 150 kt and some where between 20,000 and 20,500 ft. Fueler was continued until the aircraft reached 300 kt. At a dive angle of about 75 deg, a pullout was started to avoid losing the T-33 Mach limit,

and finally the pullout was used to start another parabola.

With this technique periods of virtual weightlessness lasted 25 to 28 seconds. Initially developed with the F-33 fuel system when fuel in the main tank needed to evaporate during subsonic conditions, preventing the fuel pump from delivering enough fuel to start two engine rpm. Complete loss of oil pressure also occurred. Although the test was not successful because the J55 engine can run without lubrication for extended periods.

In order to extend the test flight period a fueler aircraft was needed and USAF assigned an F-94C to the program in May, 1955. Various patterns

were tried with this new aircraft, and again the duration was made to fly the parabolas in the area of 18,000 ft.

From about 18,000 ft., the F-94C is dove at 300% engine rpm until AAS reaches 315 kt, then a 30 percent pullout brings the airplane into a climb of 65 to 70 deg. The parabola flight in the pullover produces weightlessness for periods up to 40 sec. Using its other burner, the F-94C produced the longest period recorded—15 sec.

### Aircraft Modifications

The aircraft used in the program are standard types modified such to the extent that readiness and concern as used to record subjects' reactions. In

## Soviet Film Illustrates Preparation for Satellite Launchings



LAUNCHING sequence of rocket appeared in Soviet film, "First Soviet Man-Made Satellite." Launching, apparently of Cosmos V-1, was one of first conducted in program.



MISSILE, identified as Kosmos, is positioned vertically on its launch pad.



LAIKA (above) is strapped in special harness prior to being placed in Sputnik II. At right, dog is in compartment shortly before launch.



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light the standard G-meter is used, but an auditory indicator of G forces in three axes has been installed in the test airplane. It is a gull bell on a string in the pilot's windshield.

In the weightless state, the ball will float free and will move to indicate aircraft acceleration in any of the three space axes.

To stretch the period of weightlessness even further, the department is expediting delivery of a Centron vector aircraft early this year. It will probably be a trimmer version of the F-100. With this latter equipment, weightlessness starts up to a minute and a quarter in duration can be produced.

Major Herbert D. Stallings, Jr., has been the pilot through the flight test program. This practice has been to fly the aircraft completely through the portion never using the autopilot. Stallings feels that the pilot can give the most accurate direction to the aircraft during the zero gravity phase.

#### Recording Equipment

Movies are taken of many subjects, and a tape recorder in the instrument cabin records all maneuvers. An oscillograph also has been designed to record such physical reactions as heart action and respiration, and the zero-gravity aircraft rates. This 14-channel system is hooked to three accelerometers.

It is shown this attitude of the aircraft to zero gravity.

A T-13 chase plane is used for the flight experiments. It serves as a safety buffer because of the traffic congestion in the area and the fact that the experimental aircraft is on instruments. It carries a flight surgeon who is in contact with the subject and knows his position. The flight surgeon can call off the response if the subject appears to be sick.

Subjects chosen for the flights represent a wide range of physical and personality types ranging from novices to experienced jet pilots. Some attempts are made to use flight surgeons' medical techniques and others who can recognize and relate their experiences more precisely.

Depending on the weather and mission status of the aircraft, experimental flights are made for a day or two, and usually two to three missions are flown each day. Stallings has accumulated something in the neighborhood of 35 hrs. of weightlessness in small zero-gravity.

Doctors are studying the physiology of aspects of weightlessness, such as circulation, muscle action and other factors. They also have established some guidelines on eating and drinking problems.

It appears that eating in zero gravity

will be no problem as long as food is chewed well. If the food is belched, it may stick going down when the tract is quite moist.

#### Drinking Problem

Drinking is more of a problem. It is nearly impossible to down in a glass of water in the weightless state since the water is unobtainable and can float up the specimen's nose. Straws are not the answer, but apparently the problem can be solved by using squeeze bottles similar to those commonly used to dispense ketchup. Once the water is in the mouth, the muscular system can get it to the stomach.

Another key question involves the effect of weightlessness on sleep. This is a problem in setting work cycles, but apparently the answer will have to wait for an extended flight in space.

Weightlessness experiments have developed varying reactions. Some subjects have a feeling of euphoria, relief and relaxation. Others don't grasp it so much, and a number of them have developed motion sickness.

#### Motion Sickness

Although the number of subjects developing motion sickness is relatively small—35 to 30%—this development could seem to imply that future space flights may have to be screened to deter

some future behavior, for weightlessness according to Dr. Shepherd J. Gaulty would, in fact, mean losing the zero-gravity experience.

Dr. Gaulty noted points out that only about half the subjects developing motion sickness are, probably, naturally sensitive to weightlessness. Some subjects who are sick at the onset of the flight build up a resistance to the sickness.

That means of experiments to determine that possibly only 15% or so of potential space travelers will be harmed by sensitivity to the weightless state.

#### Sickness Cause Unknown

Silent symptoms of sickness caused by weightlessness appear in 60 sec. or less the trouble is somewhat different from sea sickness, which takes 15 to 20 min. to develop. It hasn't been determined whether it is the change in zero gravity or the state of weightlessness itself which produces sickness. With sea sickness it is the change from acceleration to deceleration that does it.

Disorientation has been used with a remedy for motion sickness and some subjects in the experiments said they were helped by taking the drug. Others were not. No concrete testing of the effects of drugs has been done.

Mid-air rendezvous coordination is necessary to adjust to weightlessness but it is fairly easy to train such things as out-of-control. Effects of the state on crew coordination were tested by having subjects simulate a target with a stick during the zero-gravity conditions. There was a mild disturbance of accuracy, but subjects quickly adjusted to it.

#### Possible Sickness Cause

Dr. Gaulty noted that fact, are probably both psychological and physiological roots in the motion sickness induced in weightlessness. Sensing or getting personal physical changes and possible adaptation and recovery also have their effect. To curb these latter effects, subjects are now brought to familiarization flights before then going through the zero-gravity experiment.

Problems of long periods of weightlessness having adverse effects are small according to Dr. Gaulty. He feels that the initial period where adaptation comes is the most critical and that if the space fleet tolerates a night's duration at day, he probably will be all right on a long flight. Conversely those who don't adapt well at first may never develop a tolerance for weightlessness.

Dr. Gaulty's conclusion is that there should be no reluctance to send

people into the weightless state for longer periods of time. He said that he wouldn't mind taking a flight for as long as he wanted. If I learn the rules, he said, especially since the pilot could assist the aircraft to return weight if he got in trouble.

For the shorter trips into the upper atmosphere and into free space, he said it will be able to run their own supplies of oxygen and carbon dioxide. But when space travel is full-time, one or two months, new methods will have to be found to maintain a habitable atmosphere in the space cabin.

An answer to the problem may lie in the experiments in space stations being done in the Space Shuttle and Department 10.

#### Photostation Studied

Researchers are wondering whether it is possible to use photostation for a gas exchange system. This would assist processes to remove the human risk of absorbing oxygen and producing carbon dioxide. Through photostation, plants respond to light absorb carbon dioxide in their cell matter. Hydrogen in water is used to reduce carbon dioxide to a carbonaceous material, oxygen from the water. The carbonaceous produces approximately one molecule of

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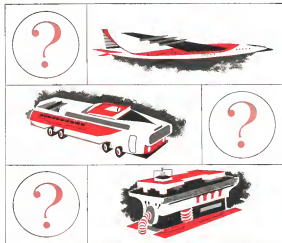
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A closed system using the principle of photosynthesis currently is operating here with two water-sealing chambers. The main one is a sealed chamber from which carbon dioxide is removed and exhaled through the system, and oxygen is returned for the next to breathe. The air is pumped through a bacterial filter when it comes out of the chamber, and it is detoxified before it goes back to the race.

## Algae in Suspension

Heart of the system is a large tank filled with algae in suspension. The highest rate of photosynthesis is found in microalgae, also, according to Capt. Robert D. Gifford and a type of blue-green algae is used. This type has a high surface-to-volume ratio and a naturally high optimum temperature for growth. That leads to less cooling problems—over high temperatures, it inhibits the growth of bacteria.

The tank holds 20 liters, which is more than the compressed amount is required in two mice, but the system doesn't get full oxygen from the algae because of incomplete illumination. Six ordinary white light fluorescent lamps are extended down into the tank in Plexiglas tubes. The algae now get 90 to plus ambient light, but this will be increased to 120 w.

The algae is fed a liquid nutrient and most of it must be disposed of because it grows. There is a possibility that bacteria would be produced for use in place of the liquid nutrient and it is also possible that the algae could be used as food for a space crew.

Thus the experiment holds the possibility of a system that could absorb carbon dioxide and when bacteria waste products, aerobically stuff on them, produce oxygen and supply food. Present hardware is not perfect for space flight, of course, but experimenters are proving that photosynthesis can at least be used for a gas exchange system.

Longest period the closed system has run is four days with one mouse and two mice have lived in the system for three days. The mice were closed down for mechanical reasons, not because the device failed to provide oxygen for the mice to breathe.

## British Ready to Test Engine for First IRBM

Initial test of the Rolls-Royce rocket engine intended for Britain's first intermediate range ballistic missile is expected by the end of this month at the Ministry of Supply's Missile test base in Abingdon, Wales. Engine is built on the license from North American Avco and modified for missile design by de Havilland Propellers.

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## Missile Firm Closes For Lack of Contracts

Detroit-American Motors is closing its Special Products Division as an "uncommercial" operation.

"We have a number of completed missile people and tried for three years to obtain a contract worth of the name," President George Romney said.

"We conducted every known procurement agency. We had the contract plant and production facilities of the Harbor Motor Car Co. to offer. It is our firm conviction that we were let, proved because of an unbridled lack of confidence in our stability as an organization."

Only defense contract that American Motors is still actively pursuing involves the "Mighty Mite," a portable man-portable rocket designed for use by paratroopers. Prototypes are currently being tested by the Marine Corps.

## Rocketdyne Building Engine Service Unit

Rocketdyne Division of North American Aviation has broken ground for its service center in Canoga Park, Calif.

Facility will house division's service unit under direction of James Broad, who will have 152,000 sq. ft. of office and storage area, will cost \$18 million. Some 1,000 persons will work at facility which will support Atlas, Thor and Jupiter engine program.

Center will have three part departments, factory-to-field spare parts group, field engineers and overhaul plant. Center will have new operating hours for support of rocket engine program (AW Nov. 25, p. 16), emphasizing speed in overhaul and modification according to customer specifications. Completion is scheduled for fall of this year. Center is being built with company funds.

## Army Evaluates Cover For Corporal Missile

Plastic missile cover designed for the Army for the Corporal missile has completed over 14 months' field testing at White Sands Proving Grounds. Called the 103 cover, and made from



L-103 cover material, it is said to be lighter in weight, faster and easier to put on than any cover yet developed. The three surface covers weigh less than 70 lb. and can be put on the missile while it is on the erector in either the ground level or vertical position. Removable with one man support, the cover can be removed from the missile while it is in firing position in less than 45 sec. Builders done over access hatches and in field adjustments and maintenance.

Aircraft and field electronic equipment covers have also been developed from L-103 material. Unit is manufactured by Aeromoldex, Gardena, Calif.

## Missile Devices Firm Extending Operations

Marionas Division of Elgin National Watch Co. will extend operations of its Chatsworth, Calif., contract and development plant to include custom production as well as design of radar, missile and aircraft devices. The plant specializes in high precision components for the military. Lincoln, Neb. plant, now to be abandoned, formerly handled production of Chatsworth design. Marionas Division work will also be done at the company's new plant being built near Palmdale, Ill.

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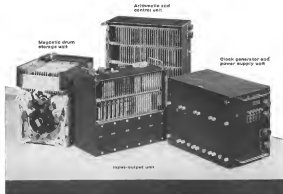
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## The Importance of DIGITAL TECHNIQUES

Digital techniques constitute one of the most important developments which have made possible the recent advances in computers and related equipment for communications, data processing, and industrial and military electronic control.

Digital computers for scientific computation range from small specialized units costing a few thousand dollars, to large general-purpose computers costing over a million dollars. One of these large computers is a part of the Ramo-Wooldridge Computing Center, and a second such unit is being installed early this year.

Electronic data processing for business and industry is rapidly growing based on earlier developments in electronic computers. Data processors have much in common with computers, including the utilization of digital techniques. A closely related field is that of industrial process control. To meet the needs in this field, Ramo-Wooldridge has recently put on the market the RW-100 Digital Control Computer.

The use of digital techniques in military control systems is an accomplished fact. Modern interceptor aircraft, for example, use digital fire control systems. A number of Ramo-

Wooldridge scientists and engineers have pioneered in this field, and the photograph above shows the RW-30 Airborne Digital Computer.

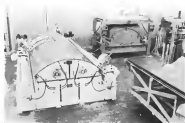
The RW-30 is an example of what can be accomplished through the application of digital techniques in conjunction with modern semiconductor components. It performs complete mathematical operations including multiplications, at the rate of 4300 per second (as fast as large electronic computers). Yet it occupies only a 19 cubic foot, weighs 300 pounds and uses 400 watts power. It is packaged in four separate units to facilitate installation in aircraft. The computer drives necessary less a supply of 2000 21-bit words.

The versatility inherent in digital techniques makes it possible for the RW-30 to handle such varied military aircraft problems as navigation, automatic control and bombing, and combinations of these problems, without changes in the RW-30 itself.

The RW-30 also serves to illustrate the balanced integration of systems analysis and product engineering which is a principal objective at Ramo-Wooldridge. Similar progress is in progress on other airborne and ground control systems, communications and navigation systems, and electronic instrumentation and test equipment. Engineers and scientists are invited to explore openings in these fields at Ramo-Wooldridge.

## The Ramo-Wooldridge Corporation

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TITAN ICBM fuel tanks are shown being prepared for weld fabrication by automatic welding machines. Photos taken at the large unit of the nozzle being built by the Martin Co.

## How Titan Fuel Tanks Are Welded

Largest precision welding tool installation ever organized in the country is now in operation at the Martin Co., Denver, Colo. Specifically designed for the construction of the Titan intercontinental ballistic missile, the welding apparatus was constructed by the Machine Welding Department of the Air Reduction Co., Nor. York, N. Y.

Included in the installation are fixtures, rotation devices, loading mechanism and other parts of the welding machine tool such as welding heads,

nozzle controls and welding power sources.

Hydrowelding, an inert gas arc welding process, is the method used in weld fabricating the aluminum sections of the missile fuel tanks.

Technicians in lower photograph are engineering the weld while the auto rotation operation is in progress.

The Martin installation is one of 40 custom-engineered by Aero's Machine Welding Department since its inception in 1957.



FIRST photo (below) of fabrication of the Martin Titan, being built for Air Force, shows "cage pot" sections being welded to form part of missile fuel tanks.

## New Aeroquip Strap with Ratchet Buckle

FOR AIRCRAFT CARGO CONTROL



At Lockheed Aircraft Corporation, the new Aeroquip 5000 lb. Ratchet Buckle is used to hold the forward

flight section of the prop jet B-70 as it rolls forward during production stages. An easy ratcheting and auto-release buckle, it actually takes up to 4 feet of slack under increased load, and at the same time, loosens a handle that can reach up to 500 lbs. Operates as a ratchet which... can be used with any length webbing. There are all kinds of manufacturing and usage applications. Retain the coupon for full information on this and other types of cargo control strap assemblies.

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One important phase in producing reliable products is careful control at each step in the manufacturing process. The assembly of the tiny Hughes electronic devices at left,

for example, is carried out under glass in a dust-free, non-ion-free atmosphere. The care given these "incubator babies" assures the quality needed for reliable performance.

Reliability is given high priority in every phase of the Hughes operation. Years of study and experience—in research, development, and manufacturing—have given Hughes electronic instruments systems, radio warning systems, guided missiles, and commercial electronics products a reputation for high standards of performance under all kinds of conditions.

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CATAPULT crew prepares F8U-1 for launch from catapult No. 3 while stress tested by previous launch from catapult No. 4.

## F8U-1s Begin Duty on U.S.S. Saratoga

By Edwin J. Balbon

Aboard U.S.S. Saratoga—Some 1,500 officers and men of this 60,000-ton plus supercarrier are basking a host of problems preparing for night maneuvers at dusk guarding the vital Northern area waters, only 40 miles distant from Russian jet bases.

During a week, an air force 250 miles off the great carrier looms at Mayport, Fla. crew and aircraft attempted to prepare for a stringent Navy operational readiness inspection planned to test whether the Saratoga and the accompanying U.S.S. Essex were shipshape to replace the U.S.S. Forrestal and U.S.S. Randolph in the Near East.

### Carrier Problems

Among the problems facing Adm. Clifford S. Cooper, commander of Carrier Division 6, and Capt. Alfred R. Mather, commander of the Saratoga:

- Low experience level of the crew, new hands running some 30% to 50%

in main departments and some having no previous carrier duty.

- Need to break in a new carrier air group, which includes VF-12, among the first fully operational squadrons at Chance Vought F8U-1 Corsairs to come aboard a carrier.

- Unseasonable cold and stormy weather which defied the planned heavy flight training and indoctrination inside.

In addition to VF-12's Corsairs, the 77 aircraft of Carrier Air Group 1 aboard Saratoga (CVA-60) include McDonnell F3H-10s of VF-11, Douglas AD-2s of VA-16, Douglas AD-6s of VA-11, Douglas AD-6s of VA-13 and a handful of AD-7Ns and AD-7Ws of VA-12 and VA-11 and AD-6s of VA-10. Cougar photo planes of VF-62.

On Essex, in Air Task Group 201 comprising F3H-10s of VF-11, North American F3H-10 of VF-62, Douglas AD-2s of VA-16, AD-6s and AD-6s of VA-10 and North American AF-10s of

VA-17 along with some AD-6Ns of VA-12 and VA-11. AD-6s are tankers used to refuel combat air patrol planes and were scheduled to stand by for emergency refueling.

Performance of the Corsair is ahead of all other fleet fighters in range, speed and altitude capabilities, Adm. Cooper noted, adding that the F8U tested with the Navy's Silverdome infrared ranging missile is a "terrific performer." Considered as the Saratoga carry two Silverdome each, one on each side of the foredeck behind the middeck. This type of mounting was chosen by Chance Vought because it preserves the integrity of the thin wet integrated fuel tanking wing, also, other losses to the airplane's center line provides improved normal wing-coupling personnel noted.

High cost of modern fighters leads numbers that can be purchased under current budgets, their size also limits the number that can be carried over-

on legs, carries such as the Saratoga—as a result, VF-12's 12 F8Us represented total squadron strength, and no spares are aboard. This requires that the airplanes show a good schedule record. Even under the handicap encountered operating the first week aboard the carrier, VF-12 maintained a good availability, only two of the Corsairs being out at any one time, Vought-Waters was told.

Saratoga was laid out to provide easy accessibility, major portion of winging from middeck passed back along one side of the foredeck, hydraulic lines on the after side and they run out in a single accessible strake compartment behind the cockpit. Majority of the 1,000 psi hydraulic system's valves are located in a compartment in the belly, forward of the main gun well. Hydraulic panel can be rotated forward permitting easy access to this critical area.

VF-12 landed on Corsairs smoothly on the deck of CVA-60. Pilots like the comforting feel of the high-powered J57 with afterburner, get away easily as a "butter" feel—look, missing the twisting cables. Variable incidence wing also made catapult launch trouble seem smoother, the result drawing away without the rocking apparent in other types.

Corsairs and AD-2 Silverdome of Essex, latest types to join the fleet, are fitted with anti-aircrafting probes. The Corsair's is a retractable multistroke housed in a streamlined bulge on the port side of the foredeck aft of the middeck. The Silverdome's is a fixed, long external probe on the starboard side. Both types are AD-6s fitted with "Reddy" refueling gun to stretch their range in the case of the AD-2, the Silverdome feature carries sufficient fuel to use all at with almost full tanks.

### AD-6 Improvement

AD-6 is a direct replacement of earlier attack types, such as F4Us used for attack missions, according to Adm. Clifford. He noted that the Silverdome has improved bomb load and increased range over the F4U, also is easier to handle on the deck because of its smaller size. Later some with modern appearance while waiting plane handles spot the aircraft, for one thing, the air wing configuration permits close stacking of planes, leading edge to leading edge.

Standard cockpit presentation is a particular draw-letter liked by pilots. One pilot pointed out as an example the oil pressure indicator—a general presentation that tells him whether engine is normal, low high or too low. Check-outing pilots are fast for the engineering type's interest in comparing data, but carrier pilots are primarily



CREW of U.S.S. Saratoga, hard up for personnel inspection at sea, are stressed faces of the port bow. Aircraft spotted forward include F3H-10s, F3H-10s, AD-6s and F8U-1s. AD-6 attack bombers are spotted ab. Turret gun is visible ship order most.



F8U-1 at VF-12 is selected in flight by AD-6 of VA-15 demonstrating belly-up turn. Light coloring, AD-6 carries three large external fuel tanks.



BLIGHT deck crew are inspecting the deck. F3H-10s Douglas is visible behind three F8U-1s. Aircraft Nos. 205 and 204 are in position for catapult launch.

connected with a simple "go no go" system, he stated.

Plot elements indicate that the Starliner handled very, one thing that requires close attention immediately after landing is a tendency of the engine to go to the left, following the fuel centering, an abnormal nose gear which tends left plus the tendency of the airplane to roll very lightly on the nose gear.

#### Saratoga's Catapults

For launching jets, Saratoga has four blast steam catapults, two 120 ft. C-11s on either side of the forward deck, two 206 ft. C-11 MLIs on the angled portion of the port flight deck. Steam from the ship's boilers is stored in accumulation at 350 psi, firing pressure vents, depending upon the type of aircraft launched. F-4U, for example, takes about 380 psi, smaller planes between 150-200 psi. The AID takes about 300.

The catapult gets the fully loaded AID, which weighs about 70,000 lb., up to 142 ft. at the end of the catapult, the F-4U gets up to 100 ft., the A-1H, 130 ft. A Douglas II guided missile, one of which has been launched by the Saratoga, is shot off at 120 ft. Acceleration at the end of the catapult is calculated at some 10 ft. above maximum speed, winged.

Planes can be spotted as one of the four catapults, although usually the AID is not launched from the No. 1 catapult, which is in line with the island, except during trials. Reason is that the rotating, retractable jet blast doors behind the catapult are designed for single-engine types and mounted 185° of the AID would blast the island area.

Modified blast doors with three-section hinged gates, are planned for installation to permit greater versatility in launching the big AID, Avondale Wren was told.

#### Picket Duty

Four-engine AD-5s make normal intercepts AD-5Ws of VAW-12 are used as radar pickets, extending the range of the carrier's normal warning radar gear. Picket mission is to alert the carrier to low flying attacking aircraft trying to sneak in under the carrier's radar, secondary job is anti-submarine warfare. Mission normally last about 3-4 hr., with the planes orbiting in three search patterns at approximately 2,000 ft. One of the Navy's largest units, VAW-12 has some 170 officers and 61 aircraft, from which it supplies picket assets for all carriers serving the Atlantic fleet.

Defense of the ship units generally with the lighter squadrons—CVAs-60's defense assignment is more complicated even to its World War II mission.



FIG-1 Carrier from Spokane VF-81 takes "catshot" from port catapult of U.S.S. Saratoga. Visible position wing is visible in slow speed attitude.

Plans call for replacing guns with surface-to-air missiles.

With squadrons kept down to the minimum of aircraft needed and no spare planes carried, stocking necessary volume of spare parts to provide pull-and-replace maintenance is one of the most problems on the great carrier.

Aviation Stores Division of Supply Department is responsible for engine, powerplant and all electronic spares, in addition maintains inventory control of jet fuel, aviation gasoline and oil and hydraulic fluids.

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ORANGEHILL crew services carrier of FIG-1 on longer deck of Saratoga. Back on side of aircraft above open access door to Starliner's mainline.



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Indebtedness and that storage space for spare aircraft material is a critical spot on even such a large carrier as *Saratoga*.—Aviation. Means. Division, noted that some 20 classrooms and five available additional 20 storage spaces.

## Inventory Difficulties

But one of problems mentioned often in discussions with the numerous manufacturers' technical representatives aboard was their inability to locate material that had been brought aboard. One such representative told *Aviation. Means. Division* that to overcome this problem, he had personally supervised loading and storage of his material and made up lists showing what type of material was stored, where, so that squadrons could quickly find needed parts.

Representatives from *Aviation. Means. Division* picked their material in lists covering complete inventories for various types of planes and personnel supervised their loading. Incidences in which spare off-loading, they said. This hope to introduce the system to other carriers.

Attempt to meet heavy training schedule in preparation for operational readiness operations was severely handicapped by minor setbacks which also pertained plans for night flying operations.

In addition, low experience level of the flight deck crew slowed the pace of planned flying. The new men, considered the first few days, near the end of the week operations were going noticeably smoother.

Ship's officers said that by the time the ship arrived in the Mediterranean, in some three weeks time, the team would be developed to a high level of proficiency.

## Inexperienced Personnel

Aircraft handling officer said that he had some 50% turnover in his 600 personnel working the flight and two zero fighter deck, and more, had never seen an airplane land as a rescue. This was noticeable at first in the time it took to get planes ready on catapults, crew of two more people moving in to do a particular job and then getting clear in an almost instant manner, further slowing operations. When an A-10 lost a tail fin on catapulting deck, crew was slow in getting to the airplane when, after the landing, had poured out causing a momentary flash for that which enveloped the entire plane.

The boat staggered and was delayed in reaching the airplane, as was the plane's ladder.

During this period of skeleton-banned officers and many crewmen were getting only three or four hours of sleep a day, in some cases sleep as late as their work.



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ROBERTSON Aircraft Corp.'s VTOL prototype uses vectored diphasers, is powered by supercharged 340-hp. Ecocraft GSO-400 engines.

## Robertson VTOL Makes Tethered Flight

FL. WASH., Tex.—Tethered flight tests started here Jan. 15 on a new vectored diphaser type vertical takeoff and landing airplane designed by Robertson Aircraft Corp., a subsidiary of Aero Design & Engineering Co.

Developed as a private venture, the aircraft is aimed at the military market and has been shown to military representatives. Designers say this jet could take the first aircraft "with open a new realm in fixed wing aircraft flight."

Robertson VTOL is a four place aircraft and has a high speed cruising range of about 1,000 mi. Robertson dropped the flying test bed stage and has produced a prototype designed as an operational airplane.

It is powered by supercharged 340 hp. Ecocraft GSO-400 engines and can be adapted to turboprop operation in the future.

The VTOL utilizes a vectored diphaser and conventional controls. Eversion flap system used for lowering aircraft into a low aspect ratio wing in cruise configuration. The aircraft has plans a slanting flap, and all control comes from the double slotted full span trailing edge flap.

Leading edge slant used on the VTOL is a boundary layer device which produces trim equilibrium. This is a technique National Advisory Committee for Aeronautics advises for use in hovering and transitional flight.



All fuel and oil for four place VTOL is carried in the tip tanks which double as end plates to increase cruise efficiency of the low aspect ratio wing in cruise configuration.

All fuel and oil for the VTOL is carried in the tip tanks which double as end plates to increase cruise efficiency of the low aspect ratio wing in cruise configuration.

End plates also improve characteristics in ground effect, and moving fuel out of the tips simplifies wing problems.

Robertson Aircraft Corp. was formed in October, 1950. On the basis of its

VTOL design proposal, designer James Robertson received an agreement two months later in which Aero Design acquired control of Robertson Aircraft and the company became an Aero Design research and development subsidiary.

The VTOL project started as a pure research project. Aero Design has invested about \$200,000 in the project so far.





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time and station.

Bell has built more helicopters than any other manufacturer. The 2,000th edition of the distinguished 47 model series, the Bell Ranger, has rolled off the assembly line and joined the hundreds of other Bells at work for many of America's best-known companies. In the Armed Services, in business and industry, it's the most widely-used helicopter in the world.

For the Bell 47 represents 2,546,000 hours of flying experience...the equivalent of almost 500 years of flight time. It has stood not only this test of time, but has proven its ability in true-life tests of climate, altitude and terrain in 52 countries.

From its military success on the battlefields of Korea, the Bell has gone straight to commercial success in hundreds of peace-time uses. In such fields as oil, manufacturing, construction, utilities and agriculture, as well as in defense work, the Bell is proving its worth, paying its way, many times over.

And the Bell 47 continues to be lowest in initial cost, lowest in maintenance, largest in service life between overhauls...and most advanced in operational features. Look to the 2,000th Bell, and the thousands that will follow, for continued leadership.

customers, action from the end-user. The Chinese, which has been awarded the same, agreed in which they eventually engage Communist jet along the northern border. The planes are combat made, except that ammunition transfer is removed from gun-on-exception being where they perform locally at Taiwan. The pilots are members of a combat unit and have more

data besides accidents. Nothing special in the type of equipment or team training is given the team. Capt. Sidney S. Yahr, USAF, is assigned as Military Assistance Advisory Group Operations Advisor in the unit to which the Thunder Tigers belong. He has flown approximately 600 hours with the Chinese pilots during the past 21 months.

major English-speaking nations adopt in a standard in international and which equal to 0.0144 inch. This, in turn, would establish an international standard equal to 0.0144 inch. In an American voice vote, the American Ordnance Act passed in the end to support Dr. Auer's proposal.

In the Soviet Union, Dr. Auer said, the value and importance of precise measurement is fully appreciated. The Soviet Union First-Test Program developed in 1950, for example, has many as chief objectives the following: Establishment of a total of 170 calibration centers which will put on the accuracy of all instruments used in Russian laboratories and plants; setting of production of instruments for all kinds of measurement and the creation of 100 additional plants for producing metrological instruments.

The greatest single impetus behind this drive for greater precision both here and in Russia undoubtedly stems from the fast growing importance of missiles. Robert Cahill, deputy director of the Army Ballistic Missile Agency's Industrial Operations Division, stressed the importance of accuracy in the manufacture of large ballistic missiles which contain 6,000 to 16,000 components and 20,000 to 30,000 component parts. In using these missiles, Cahill pointed out that Army Ballistic Missile Agency established its long-range standard in comparison with the National Bureau of Standards of the WWV, to an accuracy of plus or minus

## Standardization, Closer Tolerance Needed in Production Calibration

By Michael Yaffee

**Bethel, Me.**—One-eighth of an inch can make a big difference in U. S. military capability. Just how much this variable has meant to the country's military might was the theme of the 11th Annual Meeting of the Bureau of Standards and Metrology Division of the American Ordnance Association held here at the Air Force Center, Rockwell Center.

One eighths of an inch is the highest accuracy with which the National Bureau of Standards has been able to calibrate and certify master gage blocks. In fact, these gage blocks have served as reference standards for controlling production tolerances to a hundredth part of an inch. Until recently, such tolerances adequately met the demands for accuracy and reliability needed in weapon technology.

But the advent of air, high performance, weapons, detection and control systems has outstripped these standards.

Today, the demand is for control of production tolerances to within a hundredth-thousandth part of an inch. This, in turn, means master gage blocks that can be calibrated and certified to one or two ten-millionths of an inch to maintain this accuracy and reliability from the production line to the aircraft line, it also means the establishment of field facilities with test equipment and measurement standards having accuracies heretofore found only in precision metrology laboratories.

### Program in Progress

With more of this need for greater precision, the more than 130 metrologists who attended the meeting worried to know what was being done about it.

For one thing, said A. V. Auer, director of the National Bureau of Standards, the Bureau is making good progress on the development of the metrologic standards required. Dr. Auer believes that by 1958 the major national standardization laboratories throughout the world will agree on using the same length corresponding

to a specific exact number in a specific atom (caesium 133) as the unit standard for all length measurements.

Meanwhile, Dr. Auer pointed out, there is need to standardize the units among the "three major English-speaking and speaking countries," the United States, England and Canada. The national differences in the three scales (approximately 1/16000 in, 1/120000 in, 1/100000 in) created confusion and mistakes during World War II in the exchange and mutual use of precision instruments and components. And with today's trend toward ever increasing precision, the deficiency and confusion would be compounded in the event of future technological changes.

To end this on-going measurement standardization, Dr. Auer proposed that the



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## THE ARMY H-23D ...

### HELICOPTER WITH TOMORROW BUILT IN



Design of the basic H-23 helicopter was largely governed by a doctrine of ruggedness. It has produced a dependable helicopter, with a record of safety unequalled in its class.

Now, in the H-23D, a completely new 1000-hour+ drive system is introduced, seen as a major break-through in lower operating costs. A full-time 250 horsepower is available and, significantly, without "redline" restrictions warning of jeopardized service life. Thus, ruggedness has also afforded growth potential.

In the H-23D, growth potential assumes a new importance. Its existing components are designed to accept even greater power increases for the future's most challenging performance demands. Now, more than ever, the Army H-23 is an investment in tomorrow.

one part in 1000.

Proven measurement is also vital in portions of the assembly of the tandem, ruggedized main, assisted Robert Lord of the U.S. Naval Ordnance Test Station. When a rocket is ungraded, the matter of thrust alignment is at the utmost importance. Whether the rocket is launched from ship, plane or ground ramp, it is essential that the thrust axis runs directly through the center of gravity.

#### Air Force Measures Up

The Air Force has assigned responsibility for its calibration center to the Air Materiel Command. Primarily, this involves the control of test equipment and measurement standards used to maintain accuracy and reliability of weapons systems.

The importance of this work should be readily apparent. declared Col. J. C. Schneider, USAF, chief of quality control. Recently, a flight of Strategic Air Command tanker aircraft crashed at a fueling station with a group of 8-17 bombers. Due to loose air navigation instruments introduced by faulty test equipment, because the same operators, and Col. Schneider if that analogy has had occurred on an actual combat mission, scoring included over-water flight.

Air Materiel Command's responsibility does not extend to an Air Force missile test center such as the one at Patrick AFB. But it will cover operational missile bases which then come into existence as well as other stations and regular USAF bases. In fact, the Air Materiel Command plans to establish calibration facilities at 250 bases. The test center is already in operation at March AFB, Calif.

#### \$25,000 Per Each Base

Col. Schneider estimated that it will cost \$25,000 to equip each base calibration center. Over the base facilities will be Air Materiel Command personnel, measurement laboratories located at eight field offices in the continental United States known as Air Materiel Area. These Air Materiel Area Laboratories, which cost \$500,000 each to equip and are now operational, will provide calibration service to the base units.

The standards at each Air Materiel Area laboratory are calibrated once a year with transfer standards which are calibrated by the Air Force standards located at the USAF depot at Dayton, Ohio. Dayton AFB is in effect an Air Force Bureau of Standards.

The Dayton Standards are certified for services by the National Bureau of Standards once a year. To speed up the calibration cycle, Air Materiel Command personnel maintain a calibration detachment at the National

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- \* MIL-T-4735

#### \* AN-T-6P

- \* AN-PW-3550a

#### 4135 GRADE

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- \* MIL-T-6732

#### 1025 GRADE

- \* MIL-T-5066
- \* AN-PW-3845

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## op' por·tu·ni·ty



## KEY OPENINGS IN 4 ADVANCED ENGINEERING AREAS AT VOUCHT

## ADVANCED WEAPONS ENGINEERING

This Vought division is planning, analyzing and preparing new concepts in missile and high speed weapons systems. Missiles and weapons are studied for air weapons, feasibility studies conducted, and proposals prepared.

Staff openings exist in both the Advanced Missile Technical Group and the Advanced Aircraft Technical Group. These are responsible positions for engineering specialists and for design engineers on through lead level. Following are requirements for 4 openings which are typical of others in this group:

**Electro-mechanical Systems Analyst, Aerospace, Electrical, or Mechanical Engineer** (M.S. preferred) with at least 3 years experience in guidance controls, flight performance, design and/or computer applications of aircraft path. To study advanced weapon systems for guidance, control, and/or systems.

**Radar System Engineer or Specialist, Aerospace, or Electrical Engineer** (M.S. preferred) with at least 7 years experience in radar and/or device for radar and its control. To make high-level studies of advanced guidance and control systems.

**Advanced Weapons Staff Engineer, Ph.D. or M.S. preferred** with at least 10 years experience in guidance or navigation and control systems. To develop completely new concepts in guidance or navigation or control systems.

**Electro-mechanical Systems Engineer or Specialist, Aerospace, Electrical or Mechanical Engineer** (advanced degree preferred) with at least 3 years experience in autopilot, flight control, stability systems and/or control guidance systems and device work. To make high-level technical studies of weapon control and stabilization systems for advanced weapons.

**Advanced Weapons Engineer, Aerospace, Electrical, or Mechanical Engineer** (M.S. preferred) able to develop methods for dynamic stability and turbulence studies. To give in- or develop studies in dynamic stability, dynamic stability and/or airframe configurations, and to make flight path and trajectory analysis. All 4 openings are full-time positions.

**AERODYNAMICS** Some of Vought's most vital and interesting problems are in general aerodynamics and aerodynamic flight tests for hypersonic weapons. This work involves preliminary and preliminary aerodynamic studies, control system methods and other responsible investigations. Staffed in a number of areas are Vought's low- and high-speed wind tunnels with a speed range from Mach .01 to 6.0. A limited number of additional specialists may find assignments in such state-of-the-art Vought's aerodynamic activities. These areas may have general aerodynamic experience, or a good background in supersonic internal systems, shockwave and/or shock wave analysis are three 3 jobs.

## e·con' o·my: when round-trip missiles save taxpayers \$102,950,000

Most missiles land head-first — and, like a bomb, just once. This destruction is desired in a missile strike, but it makes development costly. Scores of missiles often are expended before development problems are solved. Vought's Regulus I and II reduce the expense by their third application. Third-of-three versions of these guided missiles can strike head-on, with a devastating nuclear warhead. Test and training errors, used in development, can be recovered to fly again.

One Regulus was down and recovered 29 years — another only 36 seconds before. So limited recoveries of both missiles have saved \$102,950,000 and gained an inestimable quantity of technical data.

Regulus I has around submarines, carriers and carriers with a nuclear punch since 1952. Regulus II, with a range of more than 1,000 miles and able to exceed twice the speed of sound, will join the Navy's underwater and surface Navy fleet.

Scientists and engineers pioneer with Vought in new missile, missile control, and electronics programs. For details on select openings write to: C. A. Biss, Supervisor, Engineering Personnel, Dept. M-2.

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**STRUCTURES** Structures work at Vought is an interesting combination of research, design, and test — a balance of practical and theoretical problems. Most tests in wind tunnel and on model tests involve the high-speed digital computers used and extremely fast stress, strain analysis, and dynamic response calculations.

All lead and staff levels in the activity, a few positions of responsibility are open. Research activities in new solid and liquid rockets in applied mechanics or aerodynamics, or in new solid and liquid rockets in aerodynamics.

**Engineer, Specialist, or Staff Engineer** (Ph.D. or M.S. preferred) with at least 10 years experience in dynamic stability and/or similar work with emphasis on their application. Especially those applied with high-speed wind tunnel engineering experience. To control air dynamic testing, flutter and vibration and, possibly, on aerodynamics.

**Lead Structures Structures Engineer, Mechanical, Aerospace, or Civil Engineer** with M.S. or B.S. in Engineering with an M.S. in Math Also, 5 to 7 years experience in dynamic and aerodynamic, flutter and vibration, aerodynamic and missile landing systems, structures design and testing. To direct small group of engineers in dynamic, flutter and vibration tests, and in stress analysis work.

**Lead Structures Test Engineer, Engineer** (M.S. preferred) with 5 years experience in systems or related field involving power controls, hydraulics or hydrodynamic systems and control systems. To direct groups of engineers in work on structural strength elements, components and complete aircraft, substructure work and report writing.

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**Vought Aircraft**  
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**AIR-GROUND** public radiotelephone, now undergoing evaluation in Milwaukee, enables airborne passengers to place or receive calls to or from almost any telephone in the world. Base station antenna (right), located in Chicago, links airplane with . . .



## Airborne Telephone Arouses Enthusiasm

By Philip J. Klaus

**Milwaukee**—Public regional telephone service, which enables an airborne passenger to make or receive telephone calls to and from almost any spot on Earth, is generating enthusiasm among users participating in evaluation tests.

If the Federal Communications Commission finds it possible to allocate the necessary channels in an already congested radio spectrum, it seems certain that most airlines and business aircraft will be equipped so that their passengers can place and receive telephone calls on the air or quickly and easily at their homes or offices.

Trail weight of the airborne equipment developed here by AC Spark Plug is less than 40 lb., including handset for receiver, handset, selective calling and antenna.

Although AC has not set any price, equipment cost is expected to be quite modest.

Public regional telephone service is undergoing evaluation tests in a limited **aircraft** area which includes major portions of Illinois, Wisconsin, Indiana, Michigan and Ohio under a one-year contract awarded by FCC. All air-ground contacts are made to one of two base stations. One located in Chicago, is operated by Illinois Bell Telephone Co.; the other, an AT&T unit, is operated by Michigan Bell (M&T) Sept.

21, p. 41). Because the regional radio operates in the ultra high frequency (UHF) band, remote aircraft is available talk to equipped aircraft flying within line-of-sight range of one of their base stations.

### Speedy Service

Placing a telephone call from aloft is hardly more involved than making a conventional long-distance phone call. The change usually is made slightly more than for a conventional cell. Telephone call from an airplane can be made "coldest" or changed to the nearest home, with originating on the ground cannot be made "coldest."

Airborne passenger lifts the handset telephone handset off its back, depresses a button on the handset handle like a couple of seconds. The "select" tone (voice operated), then allows it. At least immediately a female voice answers: "This is Chicago (or Detroit) Aviation Service."

Speaking at a ground telephone cell, one local airborne passenger then identifies his aircraft by an assigned cell number indicates airplane's approximate position, gives home city and phone number of party he wishes to talk to. Usually within a matter of 10 to 15 sec the call is completed, leaving him telephone handset or other than voice transmitted in ordinary telephone service.

Calls originating on the ground for

passenger aboard an equipped airplane can be made as quickly, providing air plane is flying within line-of-sight range of one of the two existing base stations.

Part of the ground reach also includes operation for Chicago or Detroit Aviation Service, gives the cell number of the aircraft or airborne identifier. Base station operator then uses selective calling system which flashes a light and sounds a siren or buzzer in the airplane being called.

Only significant difference in procedure between regional telephone and regular telephone service is that the airborne passenger must wait for the base station before talking, alone it is later. However, this technique is quickly mastered and could be eliminated, if desired, by increasing equipment size and cost, according to Arthur Bess, head of AC's Commercial Electronics Department.

### Evaluation Installation

Total of 16 AC Spark Plug airborne equipment have been installed for the current evaluation tests. This includes one on a Northwest Airlines Boeing 707, another on a United Air Lines executive Cessna-340, another aboard a Civil Aeronautics Administration airplane. Remainder are on business or corporate aircraft, including a Cessna 310 operated by Gen-Air of Milwaukee in charter service.

In the several months that service has



**AVIATION SERVICE** operates in the ground Bell System land line to other parts either on ground or in specially equipped airplane.

been in operation it has been put to a number of tests. For example:

• **Ground Control Approach (GCA)** is to Chicago Midway Airport, enabling flight of airplane's normal two-way air ground radio, made use of public address telephone, connected directly into GCA controller's room to receive toll-free instructions.

• **Air ambulance service**, serving two out of passengers to Appleton, Wis. was able to telephone ahead to hospital and arrange for ambulance to meet airplane at airport. Al Goodman, Gen-Air vice president and chief pilot, told Aviation Week he also used air-ground telephone to arrange ground transport for him and for other special needs of his charter passengers.

• **Up-to-the-minute weather reports** have been obtained in pilots by telephone directly to Weather Bureau headquarters when they encountered an expected bad weather conditions.

• **International telephone call** from Beal to Copenhagen executive's office was made while enroute was en route to Chicago in a corporate airplane equipped in AC Spark Plug. Call was quickly transferred and completed between airborne executive and a business associate located thousands of miles away on another continent.

### Infight Demonstration

Aviation Week's reports was given a demonstration of the new air-ground telephone service in a Gen-Air Cessna 310. Flight 7:50 p.m. over northern Wisconsin, reporter placed and completed calls to New York and Washington.

As quickly as it is convenient, for not just pilots to ground calls. One call, to Cedar Rapids, Iowa, encountered a busy circuit. Within a couple of minutes a flashing light and chime indicated the aircraft was being called by the Chicago base station. When the handset was removed from its hook, the party was on the line.

Quality of transmission and reception is excellent comparable to regular point-to-point telephone service. Noise-canceling microphone used in the handset is made by Keweenaw Corp., effects clearance of engine noise from the airborne transmission. Flight at 7,500 ft. radio-telephone, overhead was maintained at distance beyond approximately 160

mi. away from the Chicago base station where antenna is located at a height of 144 ft. atop the Field Building. Detroit station antenna is located in an open field on edge of the city at a 35 ft. height.

### User Reactions

To evaluate equipment performance and incidents of the new service AC Spark Plug has asked users participating in service test to fill out a small form each time a call is placed or received. Information requested includes approximate airplane location, altitude, weather conditions, how long it took to place the call, whether it was completed successfully, quality of the transmission and similar details.

Aviation Week learned through more than a hundred such reports, based those to be almost universal in their praise of both equipment performance and the new service. One representative comment: "A new high in communications. Very clear, no need to talk as loud." Almost without exception ground contact was established within a few seconds, providing aircraft was within range of a base station. (If service is performed by FCC, American Telephone & Telegraph Co. plans to set up a nationwide network of base stations.)

AC Spark Plug has received many requests for the lease of additional airborne equipment, according to Bess. However, company has no immediate plans to build additional units pending clarification of the prospects of future frequency allocations for this service.

### Choice of FM

New ground and airborne equipment employs frequency modulation (FM), following recommendations made in Radio Technical Commission



**AIRBORNE** radiotelephone, developed by AC Spark Plug, weighs only 40 lb., including handset and selective calling, antenna and FM transmitter-receiver in 1-ft.-square case.



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DETROIT radio station antenna, located on city antenna, is 93 ft. high.

for Aeromarine (RTCA) special contract, No. 75 in its report 125-57/EC-722, and specifications prepared by Aeromarine Radio Inc.

Main reason for selecting FM over ultrasonic modulation (AM) is its superior effect—sharp electronic loss as FM receiver is a transmitter double perfect transmitter operating at same frequency within four-foot range. This lower susceptibility of FM to co-channel interference, permits the use of lower channels, better low audio spectrum. It is estimated that 90 to 60 channels can handle aviation's air-ground telephone needs for the next 10-15 yr.

Another advantage of FM is its ability to break down static, preclude modulation and other adverse propagation effects.

### Equipment Details

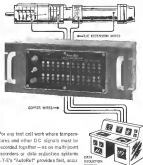
AC Spool & Plug airborne receiver, designed for operating in the 435-470 mc band, consists of a 70 mc, transmitter and a triple superhet receiver with a six-waveband converter. Both transmitter and receiver are dual tuned. They are housed in a 2 ATR-size case which weighs 75 lb including a small receiver.

The present service team all 15 equipments are being operated on the same 434-435 and 436-437 mc frequencies one used for ground-to-air transmission and the other for air-to-ground.

However, in an all-weather replacement team each airborne transmitter/receiver would be provided to one pair of the squadron, among the 40 to 50 available. To hold down airborne equipment cost and complexity and to simplify airborne procedures, ground stations would be equipped with sensors which scan the assigned spectrum, detect a call from any equipped airplane, then automatically

## T-E's AutoRef® Provides Cold Junction Compensation For Many Thermocouples

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For one test cell work where temperatures and other D.C. signals must be recorded together—as on multi-point reference or data reduction systems—T-E's "AutoRef" provides fast, accurate cold-junction compensation for the thermocouple circuit. In size, compact unit it gives you constant, pre-determined, cold-junction reference for many thermocouples—actually up to several hundred. Typically, cold-junction temperatures can be controlled to within  $\pm 1^\circ\text{F}$  over a wide range of ambient temperatures.

Besides its accuracy, the "AutoRef" offers tremendous convenience—saving both time and effort. Designed for panel rack mounting, it can be introduced anywhere in the thermocouple circuit—so matter where thermocouples and instruments are located. Whenever temperatures, pressures, flow-rates and other electrical and mechanical conditions are being recorded simultaneously, the "AutoRef" does away with the need for monitoring ice baths or making laboratory corrections. It is available for all standard thermocouple calibrations.

Write for Bulletin 21-C

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the strict National Supersonic or Reliability and Quality Control.

William W. Woodbridge, Hughes vice president and assistant general manager, emphasized that "more reliable thinking is essential on the trade-off between performance and reliability." He also noted that an expanded government sponsored research program is comprehensive development. In the past it has been "very difficult" to get money for component research and development until a definite equipment application is in sight, Woodbridge said. This is the last.

The Hughes official complained that manufacturers have a hard time getting government support for reliability research programs, despite the acknowledged need using in military maintenance costs which would rise. However, Woodbridge cautioned against the other extreme—reliability programs conducted without regard for cost.

Equipment reliability must compete for management attention with other factors in schedule, performance and cost. Until recently it has been difficult to express reliability in the quantitative terms in which reliability performance and cost can be measured which engineers, Woodbridge said, who has not gotten the same management attention as the other three factors.

Speaking of the new Defense Department program to introduce reliability specifications and test into its equipment contracts, Woodbridge said it is almost to be seen whether such tests can provide results which are representative of reliability in actual service use.

"A positive assessment," Woodbridge said, "will take a hard look at the degree of losses risk involved in reliability specifications. There is the very real danger that too much money and manpower will be tied up in design solutions to the detriment of the really, which is to improve equipment." With experience, however, Woodbridge said he believes that reliability will become another factor which management can recognize and control.

Insurance reliability of equipment is at least partially beyond the control of the manufacturer, according to Woodbridge. He reported that data from ten test operations shows that deficiencies in reliability experienced in different aircraft groups is "more times more variable than can be accounted for by differences in the equipment itself."

## Expansions, Changes In Avionics Industry

Radio Corporation of America and Alfa Electronics Manufacturing Co. have set up an engineering staff group, known as C. Sinclair Associates, in design and build a facility at Princeton

University for advanced research into controlled thermionic vacuum tubes. The Model C Sinclair, is located at Princeton's James P. Merrill Research Center, is slated for completion in 1960.

Other recently announced expansion, merger and changes in the avionics field include:

• **General Electric** of America has contracted to acquire **Heliograph, Inc.**, maker of aviation radios, through a stock exchange.

• **Quon-Tech Laboratories** is a name of new company which will produce electronic instruments, power supplies and special purpose amplifiers. John M. van Buren is general manager. Company address: 136 Mt. Roselle Ave., Montross, N. J.

• **General Electric Laboratories** has opened new 27,000 sq. ft. engineering building, its third major addition in the past two years, at its Princeton, N. J., headquarters.

• **Viac-Nuclear Industries, Inc.**, has formed new Electronics Division which will combine company's former low line and Transistor subsidiaries under single management. Samuel K. Lockard heads new division which will continue operations in former lowline facilities in Montross, N. J.

• **Dallas Victor Co.**, Belmont, Calif., has formed new Electronics Section Division which will be headed by Glenn A. Walker, company vice president.

• **Aviation Inc.**, Linden, N. J., has added 49,900 sq. ft. of floor space, bringing number of buildings now occupied to seven.

• **Brush Manufacturing Corp.**, Glen Head, N. Y., is building 44,000 sq. ft. addition to house its recently acquired Ryan Industries Division, producer of dual communication systems.

• **Schreiber Electronics** has expanded area, 42,000 sq. ft. building at 415 Horne Road, Mahwah, N. J.

• **Elgus National Watch Co.**, has opened new headquarters for its Electronics Division at Elgus II, in 50,000 sq. ft. building.

• **Telecast Magazine, Inc.**, Los Angeles, has acquired the Telecast Magazine Production Division of International Telecast Corp. The new acquisition will be under the direction of Milton Rosenberg.

• **Consomerville Plastics Corp.** recently opened a new Thelocrite Products Division for fabricating plastic components such as radomes, reflectors and similar reinforced plastic parts.

• **Thomson Wilson Associates, Inc.**, Washington, D. C., will offer industrial consulting and public relations services to solve problems in mainly manufacturing. Founder T. W. Wilson is former Chief for Liaison and Analysis of the Air Force Office of Scientific Research

## 1957-58 FILTER CENTER

• **Ultra-Preform** Resolves Available or Inactive type resins, accurate two filter three seconds of dry deposit in single sub-second by a bonded at distance of three inches has been developed by Bell Telephone Laboratories under Air Force sponsorship. Device has all workings on the status, eliminating extra steps and contacts. Models are being built by Clifton Parsons Products Co.

• **Cloudy Central Ball-Semiconductor** industry, also, which totaled approximately \$14 million last year, are expected to reach \$200 million this year and \$1 billion by 1967, according to General Electric Corporation. Transistor, currently used in 12% of all electronic equipment produced, are expected to be used in over 60% of equipment produced in 1967. Some types of transistors may be selling for around 15 cents each by 1967, considerably below price of vacuum tubes. General Electric products.

• **Copper-plating for Aluminum-Silicon** Electric has developed process for electroplating copper on aluminum strip and aluminum wire in thickness ranging from a half-cent to 0.002 in. per



## NEW JOB AS A SATISFIED CUSTOMER

The all-included reliability already utilized by the industry by RAC is a result of the 1957-58 filter center. The 1957-58 filter center is a result of the 1957-58 filter center. The 1957-58 filter center is a result of the 1957-58 filter center.

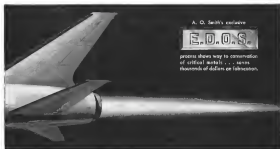
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process shows way to conservation of critical metals... saves thousands of dollars on fabrication.

## A-286 alloy ring for a finger of flame

Today, products are becoming increasingly complicated and costly. Further, there's mounting pressure to put them into production in the shortest possible time.

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Like A. O. Smith, process counts of precision forging and contour rolling.

followed by E.D.O.S. technique. With it, even the most difficult to work metal can be shaped — quickly fabricated into the parts you need with only minimum finish machining (on most cases). There's no wasted metal, no need for expensive expensive machining operations to "whittle" a part down to size. Parts cost savings of up to 75% have been reported.

A. O. Smith's 8,000-ton, single-strand,

precision forging press is the only one of its size in the country. And, this 1,800-ton contour rolling mill is also the only one of its type and size in the country.

Since World War II, E.D.O.S. has helped make A. O. Smith a major supplier to the aviation, rocket, space and related industries. A. O. Smith products are currently helping to accelerate the Vanguard project.

### E. D. O. S. applied to a jet engine case



At left is one of the best high-strength alloy metals. At right, the same blank after pre-forging. Basic material cost about 20% less than conventional process.



After pre-forging, each piece is rolled and re-rolled to obtain the final configuration. Part shown has gone through cold rolling.



Then, the pre-forged and cold-rolled blanks are formed into finished parts.



...and the 4 specimens are finished to form the finished part. Individually, each specimen is rolled, formed to shape by the customer.



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## BUSINESS FLYING



**AIRD DESIGN** Alt-Cruiser is a pressurized version of the Aero Commander 680 Super. Production model should be ready by mid of April.

## Alt-Cruiser Widens Pressurized Market

By Craig Levin

charged licensing engines. First production model should be ready by the end of April and Aero Design hopes to sell 50 Alt-Cruisers this year.

New airplane won the central theme of a national meeting of the company's distributors and dealers here, where the announcement was made that a VTOL aircraft designed by Robertson Aircraft Co., an Aero Design subsidiary, has made the first flight by an aircraft at that type.

Alt-Cruiser is essentially 680 Commander with a conventional pressurization air conditioning and heating system, plus more recent modifications. Proven standard air conditioning system and complete package.

Alt-Cruiser is essentially 680 Commander with a conventional pressurization air conditioning and heating system, plus more recent modifications. Proven standard air conditioning system and complete package.

Chief, outlined differences in the new airplane in the aircraft for the pressurized version in top of the fuselage and a split rear view window designed to accommodate a location offered to the highest version of the Alt-Cruiser. The light twin also comes in a on place without the lavatory. Both are the same price.

Alt-Cruiser has exactly the same performance as the 680. Only difference is an wings, weight of about 4,800 lb. compared with 4,415 lb. for the 680. Gross weight remains 7,000 lb. Fuel tank, weight is still unaltered and same, the prototype was loaded by the sales when it crashed (AW Jan. 20, p. 34).

Pressurization system uses standard techniques and equipment ordered to Aero Design tools by Ted Smith, vice president research and development, and his technicians. System will provide a cabin differential of 1,800/2,000 ft., giving a 9,000 ft. cabin altitude when the airplane is at 15,000 ft.

### Rate of Pressure Change

Cabin rate of pressure change is adjustable between zero and 7,000 ft. per hour with a cooling capacity of 15,500 Btu per hour and a heating capacity of 52,800 Btu per hour with the pressure control equipment of 40,000 ft. as sea level operation.

Air conditioning is provided on the ground when engines are running by a bleed system. Switch on the main gear controls the air conditioning to use an operation on taxi-out, on the ground, the system can maintain 50 deg. cabin temperature on a 700 deg. day.

Pressurization system is powered by two independent variable delivery in double pump built by Stratopower Division of New York Air Brake Co. It takes about 80 hp of each engine to run the system. Cabin temperature is a Stratopower single stage centrifugal compressor, and the supercharger turbine drive motor is built in Stratopower Avionics.

Automatic cabin pressure control equipment is an Autocrew product. And a Stratopower 200/200 turbine bleed-step cooling unit provides cabin cool

# building the structure for modern flight



## High-strength steel weldments

that develop strength of more than 500,000 pounds per square inch have been developed through an intensive, four-year research program at Rohr.

Present day advancements in the performance and speed of aircraft make this process vital for special components with very high load factors such as fuselage bulkheads, control linkages,

wing attach fittings and engine mounts. These manufacturing demands a high level of technology and specialized manufacturing equipment.

These high-strength steel weldments, now in volume production, are but one of the current structural programs at Rohr.



Mills Plant and Headquarters: Clark, Idaho; California: Plant, Elmer; California: Assembly Plant, Norwalk; Georgia: Atlanta; Washington:



ULTIMATE capacity of Aero Design's T-400A aircraft is estimated at 10,000 pounds a month on three shift basis.

ing central gasoline heater is the heating element in the system. All these components are integrated by a distributed control system. A microprocessor maintains a selected cabin temperature during either preheating or in use in operation.

## Two Pressure Systems

Cabin pressure is controlled by two independent systems, one of them an emergency system for safe operation. With the Air-Cruiser system, pressurization and its controlling can be scheduled and operated automatically. Although automatic analysis can be overridden. When the cabin altitude is selected, an indicator shows the maximum altitude under which the cabin altitude can be maintained. Rate of pressure change can be set anywhere up to 2,000 ft/min.

An conditioning cycle has four open locations. Flight automatic position means automatic operation of the valve system, and may also position in double indicator in flight heater open area without pressurization. Two other positions are for preheating operation of engine and heating system on the ground. Master switch provides positive control over system. The cabin cannot be pressurized when the switch is in "de-pressurized" position. Moving the switch to "preheating" puts the system under the scheduled pressure on the cabin pressure controller.

System includes a delay switch for control of preheating on cabin warm down and a separate switch to energize the heater in case for automatic control or shut it off.

Aero Commander's sub-vented fuselage was built up to handle the added stress of pressurization. Caps at cabin forward and aft, and pressure bulkheads were installed fore and aft in the cabin. Six bow-tie latches and two hinges secure the door, and the cabin has double windows. Pressurization cost the airplane its emergency escape hatch. There is an escape hatch in the center of gravity.

Air-Cruiser is equipped with a new instrument panel. Pilot and copilot panels contain identical sets of flight instruments although the pilot's set is electronically driven and the copilot's instruments are vacuum operated. Center panel contains engine instruments and the airplane is equipped with a new four-type control quadrant.

Three cabin packages will be offered. Available now is the Wilson-Cramer system, and Borden and Collins packages will be supplied when they are available.

To cut drag, the VHT antenna has been incorporated in a ventral fairing and a new antenna is in the wing tip. Glide slope antenna is in the nose. These modifications can have an impact on performance, however, although no measurement has been made.

## Double-Pass Windshield

Air-Cruiser has a double-pass windshield with heat pumped between the panes for efficient defogging, and there is a laminated, driven wiper on the pilot's side. Along with the pressurization system, the Air-Cruiser will also have individual cabin emergency oxygen systems with a 27 cu ft capacity.

The new airplane will have contained

refueling tests. These new tests have added amounts which can be fitted into the back of the seat when they are in the seat.

## LifeLine Battery

Air-Cruiser will be equipped with a lifetime sealed-circuit battery. Radio pack will cut into baggage space, costing about 25% of the baggage capacity of the 680.

Various other improvements have been made including retractable landing lights in the wing and modification of cabin and baggage compartment lighting.

Air-Cruiser will be equipped with a seating harness.

New airplane will be handled by Aero Design distributors under a slightly different agreement with the factory. Distribution will have to meet pilot and maintenance personnel in the factory for special training, and they will have to maintain a factory-approved Air-Cruiser service station.

Distribution will also require that personnel spend a pilot who must have a commercial pilot ticket with multi-engine land rating, to Aero Design for special training; Distribution of current model 680 and 680 Commanders who don't meet these rules will not be using used in Air-Cruiser design.

New organizational trends at Aero Design which began under reorganization of Ernst and Ernst, management consultants (AW Mar 11 p. 97) have continued through 1957. Sales department was the first target for reorganization. R. J. White took over as vice president and director of sales, and the



Can you identify them?

Know what they all  
have in common?

The aircraft shown here form the vanguard of the modern new era of commercial and military aviation. Differing in size, design and purpose, these airplanes have one significant feature in common. All are equipped with Bendix Automatic Flight Control Systems. And that should be proof beyond question that Bendix Automatic Flight Control Systems are the best answer to aviation's needs of today—and the future.

1. Boeing 707—America's first Commercial Jet Airplane. 2. Douglas 440—Bendix's first Super-sound Bomber. 3. General 802—High speed Bomber and Intercontinental range Jet Airplane. 4. Douglas A-42 J Vindicator—Bendix's first Jet Airplane Bomber. 5. Douglas C-124A—Bendix's largest Commercial Prop Jet Transport. 6. Lockheed 1042—Bendix's first American made Commercial Prop Jet Airplane. 7. Lockheed 1042—Bendix's largest Prop Jet Airplane. 8. Lockheed 1042—Bendix's largest Prop Jet Airplane. 9. Lockheed 1042—Bendix's largest Prop Jet Airplane. 10. Lockheed 1042—Bendix's largest Prop Jet Airplane.

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sales department was expanded.

Tom Harris, former director of freight sales for American Airlines, was appointed director of marketing for Aero Design last summer. Under the new setup, Harris heads a marketing committee which includes the commercial sales manager, industry sales manager and director of advertising and public relations. This committee oversees sales efforts.

Naming of Gene Charles as commercial sales manager in June headed the list of new sales appointments. At the same time, John W. Luster came to as vice president of operations to take over the production program.

Last fall, one of the original backers of Aero Design, R. T. Aas, resigned as president, and that position was taken over by George T. Faw, chairman of the board and a major stockholder.

#### Production Facility

The dedicated Aero Design main production facility at nearby Tullahoma Airport late in August. A new plant was already under construction at Tullahoma at the time, and the firm began a gradual buildup of production in the new facility almost immediately. The new plant is now finished, and the first Aero Commander not completed in December. Luster estimates that the new factory has an ultimate capacity in the range of 10-15 aircraft a month.

Discussing sales prospects for 1973, Harris said that there is no reason to believe current business patterns will depress aircraft sales. He said that the economic conditions apparent to the sale of executive aircraft still look good. Harris discussed a new, more positive sales approach adopted by Aero Design called "free travel analysis" and its rapid distribution to sales in an effort of showing businessmen that owning their own transport can be a prudent investment and can increase profits.

This technique starts with a determination of the value of a company's executive fleet. Then a survey is done to plot the commercial travel patterns of executives, determining length of haul, number who usually travel together and other factors. Aero Design then creates a picture of what an executive aircraft could do for a company in comparison to its current pattern. And a profit/loss graph can take this basic data and show what an executive aircraft can do under any given set of conditions.

Commercial Sales Manager Charles told distribution that a bad sales situation caused by the fire has been improved by a complete reorganization of the sales department on an independent basis. A new staff now concentrates specifically on sales problems, and the company no longer uses a consultant to supply for both production parts and sales.



## new BRIDGEPORT AIRCRAFT VALVES with "wear-proof" CAPTIVE SEAL

Even abrasive particles in the fluid or air stream cannot damage the seal in these small, lightweight Bridgeport Aircraft Valves. Balanced design exclusive Captive Seal prevents "blowouts". O-ring is held securely by steel retainer which provides two breaking points that instantly release pressure unbalance when seal is broken.

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## Competition Increases in Helicopter Field

By Worth-Signs of increasing competition among manufacturers for helicopter specific business were evident last week at the fourth annual National Convention of the Helicopter Association of America.

Indications of the coming age of turbine helicopter operations were also seen in the vigorous sales effort Republic Aviation is putting behind its Alouette 2, although it was evident that widespread use of turbine-powered helicopters will not arrive until some time.

Operation based on manufacturers' decision current and future helicopters. Many of the new conventional machines maintain high competition and offer operators a choice of helicopters for the first time in some categories.

Republic's Alouette 2 was a center of attention at the meeting. The company sent a large delegation to back up flight demonstration given during the two-day meeting.

Republic is selling the Alouette 2 under a license agreement with the manufacturer, Sud-Aviation. The aircraft will be built in France and shipped to the U. S. Republic is offering an immediate delivery, and the price is \$68,665.

Bell Helicopter Corp. continues to offer the Model 47 series. The Model 47J and 47G-3 are the current production versions. For the "close future," Dornier Commercial Sales Manager Paul Hincus said that Bell hopes to offer operators a commercial version of the turbine-powered H-40 and he suggested that a concept might be a prospect in the near distant future.

Helicopter Association of America delegates turned the meeting Bell plant during the meeting and saw development work being done on the Bell-Hincus Dornier turbine engine and on a new light machine developed by Bell. A key point in the tour was a flight demonstration of the H-40 for which Bell is reporting a multi-million production contract in the near future.

Another trend evident at the meeting was the expansion of manufacturers' sales programs. Rotec described the new Bell sales organization (AW Dec. 16, p. 121) and urged operators to make use of Bell sales facilities in making on their own current proposals. Other manufacturers told of similar operations in their sales organizations.

Cessna has not yet decided whether it will market its C21-1 helicopter although a decision should be announced within the next few months. Cessna has built a small number of the machine for the Army, and they are now being evaluated at Ft. Rucker.

When Cessna has some results of these tests available, the company will make a decision. No price has been announced, but it will be a competitive cost helicopter.

Hiller Helicopters is now building the H-12C with a 210 hp Franklin engine, and the company will market a new model, the H-12D-1, later in the year. It will have the same drive system as the previous H-12D, but it will be powered by a detuned 300 hp engine. First delivery is scheduled for October.

New Hiller is expected to come at about 57 ft and have a range of at least 150 mi. Sea level rate of climb will be at least 1,100 fpm and hovering ceiling in ground effect will be between 5,200 and 10,200 ft. Cost of the H-12D-1 was not announced, but it was described as "competitive for its type."

Hiller also described its Rotocycle in the operator group and asked for suggestions on how the machine might be adapted to commercial operations.

Dornier Helicopters' representative described his company's present eight plane production model. The present

one that the machine has a 400 hp engine and a 5,100 lb. gross weight allowing that it has a low power rating for its weight. Dornier built the helicopter around a simplified rotor system, and the engine's own low torque to produce a lighter weight, less complex, more easily maintained rotor drive in an effort to keep operating costs low.

Dornier holds that the tactical military requirements which now dominate helicopter design will give way to economic considerations at commercial use settings military use in the 1960-1965 period.

**Sikorsky S-62**

In the heavier helicopter category, Sikorsky Aircraft Div. of United Aircraft Corp. described the S-62, a four-blade powered version of the S-55.

The S-62 will use about 55% of the S-55's components, but it will have a new transmission system to handle the turbine engine. It will also have a solid lift and retractable gear to make it amphibious (AW Jan. 24, p. 96).

The S-62 will be available wherever the T53 or T58 engines are now rated and made available about two years from now. Price will probably be higher than the S-55 price by the

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**Red Chinese Build First Civil Aircraft**

Communist China's first civil aircraft is photographed at right. The An-2 is said to be capable of carrying aerial photographic and training pilots. Aircraft capacity is 30 passengers or 2,600 lb. of cargo.

## 113 pounds cut from the Lockheed C-130!



**PRESSURE COMPENSATOR**, or compensating bellows, applies internal duct pressure to create a force in a sealed chamber equal and opposite to the external force. It maintains a constant of total tension across the joint while leaving it free to absorb thermal expansion and contraction.

### "Balanced tension" duct system uses pressure compensator built by Arrowhead



THE BLEED AIR DUCTING SYSTEM of the C-130 is a network of stainless steel tubing running in diameter from 1½" to 4". It performs eleven functions including heating, air conditioning, de-icing and pressurizing. Using glass composite couplings, the air ranges from 350°F to 670°F, at 145 psig.

With the ducting at an operating temperature of 670° the expansion factor is .00718 for each inch of duct length. Pressure compensators were used to absorb up to 1.6 inches of growth in key locations in the 220-inch ducting system caused by the differential thermal expansion between the ducting and the supporting aircraft structure.

This system, called a "balanced tension system" greatly reduced the weight, weight and complexity of ducting supports and allowed reduction in the gauge of duct walls. On the Lockheed C-130, this system actually saved 113 pounds.

For a more complete description of the system write for the new pamphlet, "Design Engineering a Balanced Tension Ducting System for the Lockheed C-130".



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### Czech Lightplane Flight Tested

Czechoslovakia's Motus L-201 light transport, currently undergoing flight test, has 40.5 ft wingspan, 27.6 ft length, 7.5 ft height, 4,070 lb gross weight, 150 hp maximum speed, 261 mph cruise speed at 6,500 ft, 594 mi range, 11,040 lb ceiling. Engines are rated at 160 hp each.

difference in cost between the reciprocating and turboprop engines.

Sokolov is also working on the 3-61 which is described as a two turbine engine with considerable testing and work good transport application. It also has a flying boat hull.

Current Sokolov studies in production are the 5-17 and 5-18. Last week it was announced that the Czech-Light plane weight of the 5-18 has been increased from 12,700 to 13,500 lb. A different design received 19-40 hp. Aerona used for racing and performed a 190 lb increase in payload.

Superior turboprop engines for the Czech lightplane were cited by Sokolov in promoting new markets.

These new five successful units of driving up into the grades of Pilsen, proving the reliability of the helicopter in the oil industry, and the construction of transmission lines in southern California (AVS Nov. 4, p. 122), opening up another new area of operation.

Vertical aircraft outflow that was cut off field last April with the Model 42. Several modifications are in the certification process and the improved helicopter will be marketed as the Model 44.

First tests were from the Swedish unit, and deliveries began this month on the four Swedish machines.

#### Turbine Modification

Vertical has modified two of its helicopters to run the T55 turbine engine and one for the T53. Development work is being done on these configurations and the Model 44 is being sold as a machine that can be easily retrofitted to turbine power when the engine becomes available. In the near future, Vertical expects to announce another five turbine transport helicopter developed with its own small Bell announced at the meeting that

it has authority to double the overhead period on its 47G and 47G-2 helicopters, extending the time between overhaul from 660 to 1,200 hr.

Bell has also extended the requirements of the 25 hr inspection to 50 hr. Describing the new CAA-approved overhaul period Bell Service Manager William J. Dehl looked forward to a new era of increased helicopter operations. The same path major overhaul in half and contributes to a significant reduction in overhaul costs on the two Bell models.

#### Helicopter Program

Progress in development of helicopters was discussed by Joe Mathews, Bell's recently retired chief of the helicopter section. Mathews described a growing need for definite standards for helicopter location and construction, and he told delegates of recent work done by Bell Aircraft Industries and CAA to provide definite a literature on the subject.

Bell has produced a handbook of helicopter standards and specifications for helicopters as the 1,000 lb or under weight class. MAY has prepared a new comprehensive design guide covering all phases of helicopter and it will be shown to the CAA and Civil Aeronautics Board. Mathews pointed out that if CAA covers a fifth the backlog in the MAY design guide, an helicopter set under the guide's specifications would have CAA blessing.

Work, in this being time with the Urban Land Institute so that city planners will have the background on helicopter operation to meet the future community plans will include provisions for them.

Mathews noted that the standards included in the guide are rather conservative, but he pointed out that this is necessary to secure CAA approval

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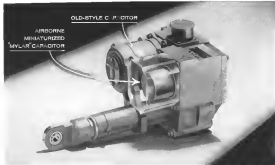
If you are an experienced pump engineer with the ambition to break new ground, tell us about yourself! Chances are, your creative ability can open up a new career for you in Rocket Engineering—more challenging, and more valuable to you than the work you are now doing. Write: Mr. A. W. Johnson, Rocketdyne Engineering Personnel Dept., P.O. Box 6633, Chicago Avenue, Chicago, Ill., California.

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Precision view shows ease of starting motor assembly used on Model R 101-480 Airborne Auxiliary Charge 30 Airborne precision miniaturized Mylar® capacitor (shown) weight of capacitor 3.5 oz., increased motor starting torque 1.5 lb. ft.

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Wood of this miniaturized "Mylar" film, Airborne miniaturized capacitors are invariably smaller and lighter than paper/film capacitors or other common constructions. Yet they have capacitance ratings up to 12 times as high as

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Airborne miniature capacitors are rated 200 V dc and have an operating temperature range of -35°F to +130°F with only 12% capacitance change. At 300°F they will withstand 150% rated voltage for 250 hr. through a resistance of 1 ohm per volt.

Standard design capacitors meet specifications MIL-C-25A and are available with three thermal options. Special design capacitors are made to your requirements and meet specifications JAN-C-25, MIL-D-67810 and MIL-M-86809.

Write, phone or tele for more information and quantities:

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Model (100's)	Size	Length
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20	1/2"	1.00"
30	1/2"	1.00"
40	1/2"	1.00"
50	1/2"	1.00"
60	1/2"	1.00"
70	1/2"	1.00"
80	1/2"	1.00"
90	1/2"	1.00"
100	1/2"	1.00"
110	1/2"	1.00"
120	1/2"	1.00"
130	1/2"	1.00"
140	1/2"	1.00"
150	1/2"	1.00"
160	1/2"	1.00"
170	1/2"	1.00"
180	1/2"	1.00"
190	1/2"	1.00"
200	1/2"	1.00"

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aid to ensure a good margin of safety. CAA is producing its own set of design criteria, but they will be confined to helicopters for scheduled operations.

In its business session, HAA decided to set up a study group to explore means of handling general aviation because HAA may be establishment of a national office and appointment of an executive secretary, or if that is not economically feasible, some alternate means will be proposed to handle common operator problems and give the operators a needed public voice.

Delegates elected Richard D. Foles, Stockton Helicopters, president of HAA for the current year. Ralph Burke was elected secretary and Robert Franklin is the new HAA treasurer. Next convention will be sponsored by Hiller and will continue somewhere in the San Francisco area.

## Cessna 1957 Sales Top \$70 Million

A 32% jump in military sales volume last year boosted Cessna Aircraft Co.'s sales volume in 1957 to \$70,849,478, giving the company a 6% increase in total sales volume over 1956.

Commercial aircraft sales dipped 1957 in 1957 compared to 1956's record-breaking year for a total of \$32,620,000. Cessna president Eugene L. Wallace indicated that company's dealers and distributors missed about-normal commercial sales as a result of 1956's record production which reflected their orders in 1957.

He noted that aircraft have been pined will below normal and expectations are that 1958 business aircraft sales will be substantially higher than 1957. Increased orders for the light twin Model 310 and introduction of the new Model 175 in 1958 will tend to give increased dollar volume for Cessna this year, Wallace reported.

Cessna reports that its orders for 50th through March are 75% higher than the same period in 1957. Military and aerospace is planned by the company this year to build new sales volume. Highlight will be direct dealings to 20,000 producers of U.S. components.

Military, plane and subminiature sales totaled \$32,470,000 in 1957 and sales of the Holmanite D-1 increased 22% over 1956 to \$4,330,000. Major factors in boosting military sales last year were increased orders of T-37A and T-19 production and deliveries of the L-17A, military version of the 310.

Military sales are expected to at least equal 1957 volume. Buckling in of Dec. 1 started \$50,000,000 and is expected to climb to over \$60 million soon.

Cessna's export sales climbed 49% last year compared to 1956 and are

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Photomicrographs show results at DETREX Soniclean. Left panel shows 4000 power at 4000 power after cleaning. Right panel shows 4000 power after DETREX Soniclean.

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## Beech Forecasts Major Sales Gain

Sales of more than 900 million are predicted by Beech Aircraft Corp., Wichita, Kan., a gain of 24% over the average of total sales in 1954 through 1956.

Commercial aircraft sales are expected to total more than 559 million in the current fiscal year compared to \$317,790,354 obtained in Fiscal 1957. Military sales in the present fiscal year are expected to decline to more \$15 million, compared to Fiscal 1957's \$65,158,735, but will be over Fiscal 1956's \$42,467,375. First fiscal quarter sales for period ending Dec. 31, 1957, rose to \$28,783,058, up slightly over the same period last year which totaled \$28,248,370.

Continued military and commercial backing as of Jan. 1 totaled more than 900 airplanes.

covered by 22.5% of the firm's commercial deliveries. Total of \$14 placed went to 33 different countries; however, a large share to Central and South America, where it has been concentrating its export sales. Company plans to increase sales efforts in other world areas soon, Wallace stated.

### Aerocar Developing Plane-Only Version

Aercon, Inc., Longview, Wash., is developing a "plant-only" version of its Civil Aeronautics Administration approved basic automobile.

New version, some MD 3s lighter than the original dual-purpose combat version, will return folding wings feature and will be able to carry two people in place of two in the Aerosol. New model will require Type Certification. Prototype is expected to start in flight test program in March.

Five flying automobile type Aerocar have been built and are operated by the manufacturer. Price of these units is \$175,000.

## PRIVATE LINES

Aircraft designers, capable of developing three business planes, is being built by Bluefield Aero Industries, Vero Beach, Fla. The company is currently working on a new design for a three-engine aircraft, which will be able to carry 12 passengers and 2 crew members.

Bell Model 47G and 47G-2 helicopters are authorized by Civil Aviation Administration to fly 1,200 ft. between maps vertical. Previously, the permit was 600 ft. Also, helicopters' 75-hr inspection has been extended from 25 to 40 hr.

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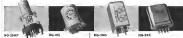
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Janitrol standard size 47 gage for compressor. 47 Fullerton size is 48 1/2 in. length.



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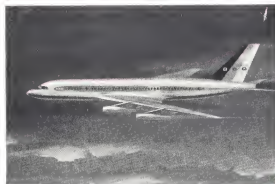
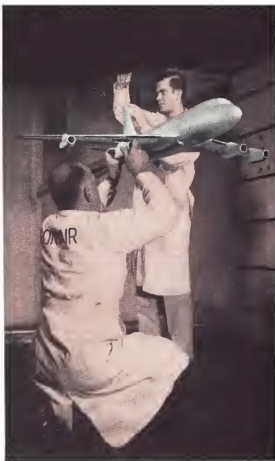
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